Shoe Heels

FIRST DRAFT

FOREWORD

This book is relatively short. It is written primarily for a general audience, although experts will obviously find it easier. I have tried very hard to make everything as simple and easy to understand as possible. However, due to unavoidable complexity, some parts still remain denser at times than I would like.

Simple anatomical terms and equivalents, as well as simple illustrations, are used throughout in the hope that non-experts might understand as much as possible, and at least the basics.

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PREFACE

By way of introduction, I am a runner. Or more accurately, and sadly, a former runner, like most longtime runners. Relatively early on in my running career I began to have an assortment of overuse injuries. That set me searching for cures. Initially I was just seeking solutions for my own persistent problems. Eventually, out of the frustration of not finding anything that worked for me, I ended up pioneering the first research into barefoot-based shoe sole designs, starting in 1988.

I had discovered back then that the human barefoot has much better lateral or side-to-side stability than conventional shoe soles. My goal was therefore to invent a new shoe sole structural design that retained that much better stability of the barefoot. The barefoot designs I developed then preserve the wider, rounded shape and flexibility of the natural human foot sole.

Within a three years I was awarded my first U.S. patent, and many more followed, including foreign patents, for new shoe sole inventions based on the barefoot.

A License With Adidas

After four more years, in 1994 I was able to license that technology to Adidas, which called it barefootwear and almost immediately made it their core technology in all categories of footwear, except old classic models.

Adidas began marketing the shoe sole technology as Feet You Wear using their star endorsing athletes like Kobe Bryant and their largest ad campaign to date. Steffi Graff used the first Feet You Wear tennis shoe to win the U.S. Tennis Open in 1996

By 2003, Adidas had marketed about a hundred different models of Feet You Wear shoes, many models in every category. However, the patent license was terminated at the end of several years of litigation over its terms.

Many more Patents

Since then, I have continued to develop and patent even better barefoot-based footwear sole designs. To date I have been awarded over 100 U.S. patents, the majority in footwear sole design, including for shoe soles with support structures that can be actively configured by smartphone control and by the cloud, as well as in other fields including designs for helmets that prevent concussions and electronic medical device implants for the human body.

I have also patented a new computer architecture with unique internal hardware-based defenses to provide absolutely reliable cybersecurity and privacy for personal computers, smartphones, or any other computer. In contrast, all existing internal computer cyber defenses are software-based and there inherently vulnerable to Internet hacking.

Research Into Differences Between Running Barefoot or in Modern Shoes

More to the point here, I have devoted an increasing portion of my time in recent years in doing what can best be characterized as an extensive survey of academic research on the biomechanical differences between footwear and barefeet, particularly during locomotion, especially running.

I have focused specifically in the fields of footwear biomechanics and human anatomy, both structural and functional, as well as related medical fields like orthopedics and podiatry, covering both injury and disease, and physical anthropology, and even a little of the chiropractic science and some other wellness approaches, like Pilates, Rolfing, yoga, and some other stuff probably too arcane for you to have heard of.

Over the years I have done an initial sort through thousands of academic research papers from as far back as the late 19th Century up to the latest research of today. I have selected for relevance over a thousand research papers and have waded slowly through them in order to complete the laborious process of analyzing them. I have also gone through over a hundred textbooks and other reference books in the same fields.

Most of these research papers and books were based on formal laboratory testing or field studies, which are generally difficult and time-consuming to complete rigorously. Personally, I do not have a laboratory with the necessary specialized equipment or lab expertise. Other than informal testing on myself and a few others, some of which has had significant results, I did not conduct any formal laboratory or field research.

In contrast, I have have worked for years to connect the dots between many research results that had already been created in the past 150 years or so, all of it in an uncoordinated and unsynthesized way.

Putting it another way, I have been working hard for years to assemble a giant jigsaw puzzle with thousands of pieces. Those pieces did not come all together in a puzzle box, so I had to find each one separately out of many that did not fit in the puzzle. And I had to put them together without a box with a nice picture on it of what the correctly assembled pieces would look like.

Surprising Results Develop Into Shockingly Catastrophic

That may sound like it might have been a nearly impossible task, but relatively early on I found some surprising evidence. It indicated rather strongly that common, everyday shoe soles, which must generally be considered to be pretty innocuous, have actually altered the structure of important parts of the human anatomy in ways that were heretofore unknown.

As I got much more deeply into the research in the past several years, I gradually became much more deeply surprised at what I was finding. Astonished might be more accurate. Those findings are as easy to summarize as they are hard to believe.

The Innocuous Shoe Sole Has Deformed the Structure of the Human Body In Many Major Ways

My key finding is that the innocuous shoe sole has had what can only be called a catastrophic effect on the structure and function of the human body. That catastrophic effect is quite perverse in the sense that it is incredibly subtle, sufficiently so to have escaped notice before now.

I fully appreciate that it must be impossible to believe that at this point. However, you need to recognize a vastly under appreciated fact about shoe soles. The soles of shoes are the absolutely essential foundation upon which your body has been built over the course of your entire lifetime. And it is well known in architecture that a building is only as strong as its foundation.

A fundamental insight I have based my research survey on is that any feature of a shoe sole that is structurally unnatural is potentially an important weakness in the foundation the shoe sole provides the body. Any unnatural structural feature therefore should be considered guilty until proven innocent.

While this is an obvious research bias, it is appropriate in this case, because it is essential to counterbalance the historical bias of the footwear industry, which goes very far in the other direction. The footwear industry has always presumed that any shoe sole structural design it chooses to manufacture and market is okay unless proven defective in some pretty obvious way. The design of footwear products is largely unregulated in any practical sense.

The only consumer protection regulation that I am aware of is that, in the U.S., the Federal Trade Commission prohibits the general marketing of footwear with any claims that it is “corrective”. In the 1930's, there was extensive marketing abuse of that particular term leading to its ban.

The Most Unnatural Feature of Modern Shoes: Elevated Shoe Heels

Anyway, as is obvious to anyone, including many of the researchers of the more recent studies I have reviewed, the common shoe sole has a “highly” significant structural feature that the human foot does not: an elevated heel on the shoe sole. If the typical shoe sole were as natural as the ground with which your bare foot sole normally interacts, the forefoot area of the shoe sole would be at the same level as the heel area.

That is to say, essentially flat. Otherwise, you would be, everyday and forever, standing, walking or running downhill. That is of course impossible to do barefoot. However, you do it everyday all day long in nearly all conventional footwear.

So we all know elevated heels are not natural. That much is fairly clearcut. But what specifically is their structural effect on your body? While a number of researchers have discovered adverse effects strongly correlated on a statistical basis with, for example, high heel shoes for women, no actual cause for the associated adverse effects has yet been identified and proven.

The Unlikely Smoking Gun: Elevated Shoe Heels Are the Hidden Cause of Arthritis

Most of the following chapters of this book will explore in detail the best available evidence on these

adverse effects on your body that have been directly caused by elevated heels. We will start with your feet and lower leg, and move all the way up to your head, with a look at every major body part between.

But more importantly, the best evidence I have found points clearly to the actual cause itself of the most significant of the adverse effects about which many researchers already have strong suspicions of a direct linkage with shoe heels. That is the most common form of knee arthritis, a crippling disease for many tens of millions in the U.S. But no direct cause for arthritis has ever been found.

And knowing that actual cause is critical. It enables us to identify what turns out to be a large number of other equally serious medical problems for which no cause is currently known and for which shoe heels are not even suspected. These other serious medical problems also can in fact be traced back directly to shoe heels.

The newly discovered reality is that shoe heels have comprehensively altered the shape of your body and made it much weaker and far less durable than it would otherwise be.

The Basic Structure of Our Bodies Is Deformed

Anatomically speaking, what we broadly think of as normal for a human body is distinctly abnormal, with malformed structures leading to degraded functions. Often extensive damage and dysfunction that increases over time. Structurally normal human bodies unfortunately belong only to those members of "primitive" barefoot races whose exposure to conventional footwear has been very limited or non-existent.

We Are the Abnormal Ones. Without Shoe Heels, Our Bodies Would Be Much the Same as the Bodies of "Primitive" Barefoot Races

This is the stark, newly discovered reality of human anatomy: that all known human races are essentially the same anatomically. There are no more highly evolved, modern, advanced human races and more primitive, less highly evolved barefoot races that are separated by some fairly distinct anatomical differences. There is only a single human race from an anatomical point of view, with a much more limited range of structural and functional variation.

And that one "normal" race can only be understood anatomically by studying its few remaining barefoot examples. Those "primitive" examples are the only normal ones left. The rest of us range from somewhat abnormal to very abnormal. And that range of variation is very wide and that very wide range is in itself abnormal.

A specific perversity of elevated shoe heels is to exaggerate greatly what otherwise appears to be an extraordinarily minor and poorly understood structural variation of part of the foot, magnifying its effect in a completely nonobvious way. Understanding this highly ironic effect appears to explain why "White Men Can't Jump", to refer to the popular movie of the that title.

“Normal” Human Males and Females Are Much Less Different Than We Are

Using the same cause and effect analysis, perhaps even more remarkable is the discovery that “normal” primitive human males and females are structurally and functionally far more similar than are modern males and females. The specific effect of shoe heels is to have greatly exaggerated the differences between human sexes, just as it has between human races.

To take just one example, the shape and position of the modern female pelvis has been altered in such a way so as to make childbirth much more difficult and dangerous for both the mother and the child. And the pelvic abnormality must inherently also alter the development of the fetus in the womb and therefore the further development of the child after birth as well. Untold numbers of birth and related tragedies going back hundreds of years has directly resulted from this hidden pelvic abnormality.

Human Anatomy As We Know It Now is All Based on Significantly Deformed Human Bodies

Human anatomy is currently considered to be among the most settled of all the sciences, if not the most settled. It is generally believed among experts that everything of significance has already been discovered decades or more ago, especially in gross anatomy (the study of the major structures and organs of the body, excluding the microscopic).

This is so accepted that it was national headline news two decades ago when a tiny, previously unidentified muscle was discovered in the human mouth. Most anatomical research today seems to be focused on microscopic details and the anatomies of other animal species.

However, the reality is that most of what we think we know about the human body is wrong in terms of the normal shape of its parts. What is thought to be normal is actually abnormal. So up until now what we have carefully and exhaustively studied is the abnormal human body.

We are entirely ignorant of the true structure and function of normal, healthy human bodies. We don't know what is optimal and to aim for, only what is less than optimal or actually diseased.

The extremely unfortunate result of that lack of understanding is that we have ignored the only normal human bodies in existence, thinking them either abnormal or too primitive and less highly evolved to be worthy of attention. As a consequence, I have had to dig very hard to find what very little formal published information is available on the structure of “primitive” human bodies.

That information is often unavoidably sketchy and/or very old. The lack of reliable information has forced me to speculate at times, more than I would like to, but when forced to do so, I have tried to indicate clearly that I am doing so. Wherever possible, I have tried hard to rely on the strictly logical consequences of what is well known.

Without Knowing It, You Have Been a Guinea Pig All Your Life And Still Are Today

There really is not any way to describe the situation we are all now in except to say we in the modern world are all Guinea Pigs. At least for now, we are all involuntarily participating in a huge, unguided

experiment that began when we took our first steps with modern shoes and continues through today.

Do you have choices? Can you opt out of the experiment and if so, how? We will consider those questions next.

1INTRODUCTION

At the same time that I was working on designing the first barefoot-based shoe sole inventions in 1988, I was also looking for whatever related research I could find. In a column by the then Editor of **Runners World**, Joe Henderson, I noticed his reference to an interesting study by a Canadian researcher and physician, Dr. Steven Robbins. Dr. Robbins and a colleague had surveyed the available literature on the injury history of primitive, barefoot populations[1].

What Dr. Robbins found was that those barefoot populations representing many different racial groupings had far fewer overuse injuries than were typical of modern shod populations. Even more attention-grabbing was that this was far fewer injuries despite far higher activity levels on a routine basis, often including what would be called back-breaking work in the modern world.

A little later, in 1989 I came across an injury study by Dr. Bernard Marti, a Swiss physician, who had conducted a survey of over 4,000 runners[2]. Runners typically have many injury problems. It is a big problem. Up to as many as 70% a year get injured from running.

Dr. Marti could find only one variable that correlated with injury: the price of the running shoes. The more expensive the shoe, the greater the probably of injury. In other words, the more the footwear industry puts into their designs, the worse they become in terms of causing injuries.

It was hard not to conclude from these studies that the designers of modern shoe sole must not have a good idea of what they are doing. Overall, the design of most modern athletic shoes is roughly the same. With minor variations, the shoe designers just use the basic design that is already out there. Then they add whatever neat new cushioning or structural “improvement” that they can contrive and use it on the convenient theory, I guess, that it has to be good since it is new and different.

Unfortunately, it is difficult not to conclude that most of the “improvements” are just artificial gimmicks that all too often backfire by causing unnecessary problems because its only real use is anyway was for marketing, not performance.

That seems to be what Dr. Marti found in 1989. In 2015, Jens Jacob Andersen, founder of a Danish Web site called Runrepeat.com, compiled nearly 135,000 consumer reviews and found generally that the more expensive the running shoe, the lower the rating.

It stands to reason that if there were any firm rational basis for what they do, the major shoe companies would not be marketing several completely different sole cushioning technologies at the same time. Presumably, if they actually knew what they were doing, they would just market the best technology they had (and tell you why, with proof to back it up).

And I'm just talking about the shoe designers who are actually trying to improve cushioning performance or some other functional feature of the shoe. The actual products seem to suggest that the primary focus is just trying to come up with a cool overall design look, as well as neat color and pattern

combinations. The reality is that virtually all shoe designers come out of an art school background, not science or engineering.

Modern Shoe Designs Have Absolutely No Proven Benefit To Their Wearers

Both of the earlier studies reinforced the conclusion that I had already reached in 1988: that my barefoot-based shoe sole designs was definitely a new and better approach because they are scientifically based on the natural structure and function of the bare human foot sole.

Further reinforcement came in 2004, shortly after my patent license with Adidas ended. Professors Dennis Bramble and Daniel Lieberman published a widely reported study in the prestigious scientific journal **Nature** that evolution had created a human body that literally was fundamentally designed to run[3]. They presented compelling evidence that humans were the best endurance runners in the animal kingdom. Therefore, humans excel at "persistence hunting" in which they successfully run down far faster antelopes and other game in long hunts over relatively great distances. And they clearly did not evolve to do this while wearing modern running shoes with elevated heels.

Dr. Craig Richards authored in 2008 what I think is the most important research paper ever published on modern running shoes[4]. Simply put, his paper makes unequivocally clear that there is no existing scientific evidence whatsoever supporting any of the supposed benefits for using modern running shoes. He even challenged major footwear companies to provide supporting evidence. They have not, apparently because there is none.

"Born To Run" Popularizes Barefoot Running and Barefoot/Minimalist Shoe Design

In 2009, Christopher McDougall's blockbuster, best-selling book, **Born to Run**, was published. A brilliant book, you should read it if you have not done so already. It publicized the work of the researchers mentioned above[5] and much more. It radically changed the landscape for runners and for running shoe design. Almost overnight, many runners became barefoot runners.

In addition, many "barefoot" and "minimalist" shoes became available soon thereafter[6]. The Vibram Five Fingers, an existing super-minimalist shoe that was originally designed for water sports, was drafted for use by new barefoot runners who wanted some immediate protection from asphalt, but the least possible.

But today the barefoot revolution that started in 2009 has definitely stalled out. Lots of barefoot runners have had injury problems and sales of barefoot-like and minimalist running shoes are way down from their peak a few years ago.

It could even be said that a counter revolution has begun in the form of maximalist running shoes by Hoka One One and their many copycats. Most of the major shoe companies never really changed their basic running shoe design, although most added some minimalist and maximalist designs, probably just to meet the demand.

Unfortunately, the only thing that is evident now is that we are at an impasse. Why isn't running

barefoot a reliable way to avoid overuse injuries? Why don't barefoot-like or minimalist running shoes work either?

Why Don't Barefoot-like Shoes or Minimalist Running Shoes Solve the Injury Problem?

The second question is the easiest to answer. None of the barefoot-like or minimalist running shoes currently available that I am aware of are based on a firm scientific understanding of the anatomy and barefoot function of the human foot. More specifically, none are structurally configured so that they interact with the ground in the same way as does a barefoot sole during walking or running or playing in sports.

All of them change the natural biomechanical function of the human foot in fundamental ways. None are structurally or functionally neutral. All interfere with nature. The elevated shoe heel mentioned earlier is just one example of an unnatural feature, the most important one, but there are other ones of significance as well.

Frankly, I am very sure at this point that I am the only shoe sole designer who has approached the problem of creating a “barefoot” shoe rigorously based on the best science available to me. Also, I have rigorously and humbly put nature first, above all other considerations, to let nature be in fact the ultimate designer without unnatural interference.

In that regard I should point out at this time that I never had any shoe design role whatsoever in my license with Adidas. My license with Adidas was strictly limited to patents only.

As is customary, when my litigation with Adidas was settled in 2003, the proceedings were made confidential, so I cannot disclose what went on relative to our relationship. I can say however that personally I was not satisfied with the “Feet You Wear” models that Adidas designed and marketed.

Anyway, later on in this book I will discuss in more detail what I believe can be done to actually improve shoe soles very significantly. You can judge then whether what I say makes good sense.

Why Isn't Running Barefoot a Simple Solution to the Running Injury Problem?

The more difficult of the two questions initially posed above is, why isn't just running barefoot a solution to problem caused by existing conventional running shoes? The answer is not good. Nearly all of this book will deal in considerable detail with what that answer is and specifically why it is not good.

For starters, as previously noted in the Preface, your body has already been altered by the shoes with elevated heels that you most likely have worn most of your life. Simply put, the structure of your body is no longer designed to run barefoot. Your bones and the joints that link them together no longer have the naturally correct shape. The range of modern individual variation in bone and joint variation is abnormally substantial, so you personally might be in pretty good shape or in pretty bad shape compared to someone else.

But the answer is even worse than that. There are substantial grounds for concluding that the transition (especially any abrupt transition) between barefoot and shod running is an important basic injury mechanism for many or perhaps most runners. Even running at different times with shoes having significantly different heel heights may produce approximately the same basic injury mechanism, one that you have probably already inadvertently triggered countless times in your life before now without thinking about it.

No Real Solutions Until We Understand the Real Problem

So, we are at a major impasse. You don't really have the option of going barefoot since your body is no longer adapted for that, nor are there any good footwear alternatives available in the footwear market now that solve the problems created by existing footwear.

Therefore, the answers to the two questions posed at the end of the Preface is a double negative. No, you do not have any choice about participating in this huge, unguided experiment with shoes having elevated heels. And no, you cannot now opt out.

At this stage, all any of us can do it to try to fully understand the exact cause of this problem and trace it as best we can to the specific anatomical and functional effects that we can identify. Then, using that information, we need to explore what solutions are available. That is what this book attempts to do.

2ELEVATED SHOE HEELS TILT THE FOOT OUTWARD

The lower leg bone is the shin bone (the tibia). The shin bone is joined to the ankle bone (the talus) of the foot to form the ankle joint. The ankle joint is a fairly simple hinge joint. It has an easy to understand structure and function.

Putting an elevated shoe heel under a heel of a human who is standing upright and stationary causes a fairly simple and automatic direct reaction by that human. In order to maintain balance in the same upright stance, the leg is unconsciously and automatically straightened from the slightly bent knee position the higher heel causes. The shin bone automatically moves backwards in an amount equal to the amount by which the elevated shoe heel tilts the foot downward.

In other words, if the elevated shoe heel raises the foot heel and tilts the foot downward by 10 degrees, then the shin bone must move backwards on the ankle joint by 10 degrees to maintain the same upright standing position. The ankle joint is then in what is called a plantarflexed position. [SEE NEW FIGURE 2.1]

There is nothing complicated in this automatic, self-adjusting reaction to the elevated shoe heel taking place in the ankle joint. This is very well understood by anyone who has ever bothered to analyze this simple automatic joint compensation motion.

Nothing more appears to happen. And is that were in fact all that happened, we would be done now, end of story. But it turns out that much more is going on when the heel is raised, even though it is anything but obvious.

A Critical Subtalar Joint Is Located Directly Under the Ankle Joint

Because directly underneath the main ankle joint is yet another ankle joint, the subtalar joint. [SEE NEW FIGURE 2.2] It is located between the ankle bone and the heel bone (the calcaneus). The subtalar joint has a much more complicated structure and function than the ankle joint.

The subtalar joint is also directly affected by the elevated shoe heel. However, it is affected in a much different way than the ankle joint because of its dissimilar structure and function. It doesn't need to be the same because the ankle joint already provides the basic hinge joint that is necessary to allow the shin bone to move forwards and backwards over the foot (in what is called the sagittal plane).

The principle function of the subtalar joint is to provide sideways, left to right motion of the foot on the ground (in what is called the frontal plane). This side-to-side motion capability is essential so that the foot can adjust to irregularities in the ground surface during locomotion. That's pretty straight forward.

But the subtalar joint is also an essential component of a larger system that controls the rigidity of the foot. This rigidity control is critical so that the foot is capable of fulfilling two essential but entirely different functions while walking or running.

The Subtalar Joint Enables the Foot to Be Either Rigid or Flexible As Needed

During the first half of the stance phase after landing, the foot must be flexible so as to absorb the shock of a ground reaction force produced by our full body weight when we land. During the second half of the stance phase, the foot must be rigid to function as a propulsive lever to push off the ground.

The subtalar joint performs this dual and contradictory role by enabling what is mostly a slight sideways rolling motion of the foot on the ground. The foot's sideways rolling motion is called pronation when rolling to the inside to absorb landing shock through greater flexibility. During pronation, the main longitudinal arch of the foot depresses toward the ground, and the heel bone tilts inward from a neutral, generally vertical position.

The foot's slight sideways rolling motion is called supination when rolling to the outside to create a more rigid propulsive lever in a plantarflexed position. During supination, the main arch is raised and the heel bone tilts outward from the neutral, vertical position as the heel is raised prior to the toe-off phase of propulsion. This rigid propulsive lever is unique to humans. Our closest living non-human relatives, the chimpanzees, do not have it[1].

The Effect of Elevated Shoe Heels On the Subtalar Joint Has Been Unknown Until Now

The subtalar joint's role in pronation and supination motion is well understood. But in stark contrast, the subtalar joint's reaction to the presence of an elevated shoe heel has not been known, much less its importance understood. What has somehow been overlooked entirely is that the elevated shoe heel also automatically causes the subtalar joint to roll the foot slightly to the outside in supination.

As a result of the supination motion, the heel bone is tilted out and the foot becomes more rigid. This is a crucial change. When standing upright, the foot is no longer in a natural, neutral position.

If the height of the elevated shoe heel is moderate, then the associated supination is also moderate. If the elevated shoe heel is greater, then the amount of supination will also be greater.

This foot supination adjustment to an elevated shoe heel is automatic. It occurs for two reasons primarily.

The Subtalar Joint Makes an Automatic Shift Adjustment to Elevated Shoe Heels

First, a powerful ligament called the plantar aponeurosis (located on the bottom of your foot sole) connects your heel bone to your toes. When the elevated shoe heel raises your heel, it automatically bends your toes upward toward you.

That mechanism automatically tightens the plantar aponeurosis so that it acts mechanically like a windlass that forces the foot into a supinated position with both a higher, more rigid arch and a tilted out the heel bone. (See Figure 2.3)[2].

Second, a midtarsal joint connects the heel and ankle bones with the middle part of the foot (called the midtarsal of the foot). The windlass action of the plantar aponeurosis acts as a locking mechanism for

the midtarsal joint. When the foot is plantarflexed by the elevated shoe heel, the foot is supinated by the windlass action and the midtarsal joint is gradually locked into an ever more rigid supinated position from a pronated position. Thus, the foot becomes a rigid propulsive lever (See Figure 2.4)[3]

The windlass mechanism is the principal way the position of the subtalar joint is synchronized with the position of the ankle joint.

Both the windlass action of the plantar aponeurosis and the locking role of the midtarsal joint are very well known in the associated fields of anatomy and biomechanics, as is their mutual interaction with the subtalar joint to form a system. What has escaped notice entirely is the role that the elevated shoe heel plays in triggering their activation as a system to automatically move the foot into a unnatural, supinated position, away from its natural neutral position.

This is a perversely subtle change. If you don't know to look for it, it is impossible not to miss it. And if you don't know it is there, it is easy to miss the effects it causes.

Negative Heels Have to Opposite Effect, Tilting the Foot Inwardly

Like the classic “Earth Shoe” of the 1960's and 70's, there are some “negative heel” shoe soles that have the opposite effect from that of elevated shoe soles. Instead of tilting the foot outward, negative heel shoe soles tilt the foot inward, in a manner that is roughly the reciprocal of the tilting out mechanism discussed above.

3SHOE HEELS ALSO TILT THE KNEE OUTWARD, ABNORMALLY RESHAPING THE CRITICAL JOINT

The reality is that human body, even at rest, is hugely complicated. Therefore, it is extraordinarily difficult and time consuming to measure and analyze it accurately. It is much more difficult still to measure and analyze it when in locomotion, even when walking. And it is far more difficult to do when running.

So much more difficult that almost all studies of the human body in motion have been when walking. Only since the 1970's have any rigorous biomechanical studies of running been completed.

Many more have been completed in recent decades as the technology has improved enough to lessen the degree of difficulty from nearly impossible (and very limited) to very hard and time-consuming but more comprehensive.

However, the basic reality is that the human body in motion is almost unimaginally complex. Super slow motion video of even a single part of the human body in motion makes this point emphatically. This inherent massive complexity has created diabolically effective camouflage for the single most substantial and direct effect caused by elevated shoe heels. The effect is maximized when you run.

The key effect is that the shoe heel induced supination moves the front of the ankle bone or talus to the outside, as already shown in Figure 2.4 above. Supination motion by itself is an inherent feature of the subtalar joint and has been known for a long time. The supination motion automatically rotates the lower leg (or tibia) to the outside[1] . [SEE FIGURE 3.1- RUBIN FIGS. 1 & 2]

Elevated Shoe Heels Shift the Subtalar Joint Laterally, Making the Ankle Joint Point to the Outside

The fact that elevated shoe heels cause that supination has not been known. That supination means the upper joint surface (the talar trochlea) of the ankle bone that articulates with the bottom of the shin bone (tibia) is pointed to the outside.

If the ankle bone (tibia) was in its normal, neutral position, your knee would move directly forward over the talar trochlea, sort of like over railroad train tracks, when you flexed your knee to absorb the force of your full body weight when walking or running. Instead, when shoe heels point your ankle bone to the outside, your talar trochlea directs your knee to the outside.

Your Fully Flexed Knee is Automatically Tilted-Out Into a Bow-Legged Position When You Run In Modern Shoes With Elevated Heels

The result of this redirection of your knees is that they are tilted outward (canted out), into a bow-legged position when you run. The more you flex your knees, the farther to the outside your knee is bent to the outside also. This is bad because when you run, you bend your knees under body weight load much more than when walking, where you leg is straight or nearly so. [SEE FIGURE 3.2 - Muybridge/Ryun]

Shoe Heel-Induced Supination of the Foot is Evidence-Based Fact, Not Speculation

Based on settled science as best we know, the shoe heel-induced supination of the foot is a closed-system mechanism has to happen biomechanically. And biomechanically the tilted out position of the heel bone is also a closed-system mechanism that has to force the shin bone to the outside, bowing the knee to the outside when you run. It is as automatic as a clockwork mechanism.

To make matters even worse, when you run, your body is subjected to the maximum force (the vertical ground reaction force) that it experiences in a routine and regular way, about 2-3 times your full body weight. And you are subjected to this maximum force when your knee is maximally flexed to about 40 degrees and therefore maximally bent to the outside. [SEE FIGURE 3.2 - Muybridge/Ryun]

Your Body Was Shaped By Shoe Heels When You Were Young and Always Running

If you think you are protected now by the fact that the last time you actually ran was so long ago you cannot remember even to the nearest decade, guess again. You still have a big problem that you cannot avoid.

That is because the basic structure of your body was formed by about age 8. The die was cast then. Experts agree that both boys and girls up to that age run almost constantly[2]. Their activity levels remains very high through puberty. After that, activity levels become lower, especially for women, at least historically. By at least one count, there are slightly more female runners today than male, but I have not found any information as to whether that is a result of Title IX or of women taking up running later in life.

So back to your problem, which virtually all of you share with all the rest of the modern world. If your knee has been habitually subjected to maximal forces when tilted to the outside throughout your life, or at least the early, formative portion of it, what would happen to your knee? Would it change and if so, how would it change?

Biomechanically speaking the issue is pretty simple. The tilted out position of your knee would increase the portion of your body weight load that was carried on the inside (the medial) portion of the knee, offset by a matching decrease on the outside (the lateral) portion of the knee.

Strong Anatomical Evidence of the Abnormal Tilted-Out Knee Position on Internal Bone Structure

A cross-section showing the internal bone trabecular structure of the knee shows the same clear evidence, with a much denser network of bone on the inside or medial portion of the knee. [SEE FIGURE 3.3 – TRABECULAR BONE ARCH]

More importantly, numerous authoritative studies agree that from slightly over 70% to just under 90% of the load is typically carried on the inside (medial) portion of the knee[3]. This excessive overloading is so great it can result in a “varus thrust” of the knee to the side when running or even when walking. [LINK TO: MAN RUNNING VIDEO] [WOMAN WALKING HIGH HEELS]

If that massively disproportionate load distribution is “normal”, then why is there a well proven direct correlation between greater load on the knee's medial portion and knee osteoarthritis. And why is knee osteoarthritis usually located specifically on that medial portion[4].

And if that massively disproportionate load distribution is “natural”, then why have numerous authoritative studies shown a direct connection between an increasing height of shoe heels with an increasing portion of the load on the knee's medial portion[5].

The answer as I am sure you can guess by now, is that our modern knees are unfortunately neither natural nor normal. They have been deformed and made much less durable by elevated shoe heels.

The Mystery of the Knee Screw Home Mechanism

To that point, in my research I came across an old but extensive written description comparing the knees of an African population with modern Western knees. It described the basic shape of the African knee as smaller and rounder[6].

The African study also made what I think is a truly startling observation. The African knees displayed little or no rotary motion in a horizontal plane, in marked contrast to the obvious rotary motion evidenced in the Western knees studied in Africa (and everywhere else).

This is an extremely significant finding. The modern Western knee joint has a well known horizontal rotary motion called the “screw home mechanism”. It occurs in the last 15 or 20 degrees of leg extension motion, as the leg is fully straightened and locked into a “close-packed” position.

Vigorous debate over the screw home mechanism has occurred over many decades and in many different anatomic, orthopedic, and physical anthropology studies. No clear consensus has emerged concerning its exact enabling structure or its function. It has remained a contriversial mystery to this day.

The Robust Barefoot Knee is a Simple Hinge, But the Fragile Modern Knee Automatically Swivels Too

So it is quite interesting that the African study also noted that the modern Western knees were subject to widespread meniscus problems (i.e. torn cartilage), which are generally associated with rotary motion in a horizontal plane. Such problems were almost entirely absent in the vast number of African knees studied and in which the African menisci were more firmly fixed.

Also, the barefoot African knees had much straighter cruciate ligaments, unlike the obliquely oriented cruciate ligaments of the modern Western knees which are a well known source of knee injury in modern populations and their twisted position also suggest possibly unnatural rotary motion.

The Surface of the Tibial Plateau of the Modern Knee Joint Is Direct, Smoking Gun Evidence of Major Abnormality

The conclusion that this horizontal rotary motion is unique and unnatural is strongly reinforced by comparing samples of our modern knees and those of some other “primitive” barefoot populations.

The lower joint surface (the tibial plateau) of the modern knee clearly shows the swiveling, rotary effect in the actual bone structure. Just as clearly, the primitive knee does not show any unnatural motion. In this example, the primitive knee sample is from an Australian aborigine[7]. [SEE FIGURE 3.4 - ABOR FIGURE]

In this figure, the primitive knee joint has basically a simple round shape, with both sides being relatively symmetrical. The modern knee has a more complex oval shape, with the sides being very asymmetrical.

This has the distinct look of evidence in the conspicuous form of a smoking gun that seems to prove a major structural and functional difference between primitive and modern knees. And there are more examples.

Similar samples from barefoot India populations show the same structure as the Australian[8]. This is true despite being distinct racial branches representing entirely different major genus homo migrations out of Africa. [SEE FIGURE 3.5 - INDIA]

The forgoing discussion strongly suggests that the rotary motion of the screw home mechanism is an artificial and abnormal feature of the modern knee that is caused by elevated shoe heels. It is not a racial difference at all. More on this later.

The Modern Knee's Motion When Tilted Out By Shoe Heels

In fact, the unnatural, abnormal horizontal rotary motion of the modern knee is a byproduct of the its structure being literally re-formed by shoe heel-induced knee cant when running.

When we run with elevated shoe heels that both rotate and tilt our shin bones to the outside under a maximal 3 G peak vertical load with knee flexed at about 40 degrees, the following joint mechanisms almost certainly must occur biomechanically:

First, the medial (the inside) surfaces of the knee are pressed very tightly together by the tilting. Therefore, the medial collateral ligament becomes very loose, allowing the condyle of the thigh bone to slide forward on the medial tibial plateau. The medial portion of the knee joint is under disproportionately great pressure during this forward sliding motion. The medial condyle forces the medial meniscus forward and erodes the forward (anterior) portion of the medial meniscus over time.

Second, the lateral (the outside) surfaces in contrast are held together very loosely by the outward tilting of the knee. Therefore, the lateral collateral ligament becomes very tight and anchors lateral condyle on the lateral tibial plateau, locating the center of rotation there. The lateral meniscus remains firmly in its natural position and intact.

Third, the outwarded tilted and rotated shin bone pulls with 2-3 G vertical force through the patellar tendon (through the patella, the knee cap) on the thigh bone (femur) in an essentially vertical direction between the two bones.

If you just look at the lower surface of the knee joint (the tibial plateau) you can see clear evidence on the surface of the bone of exactly the horizontal rotary motion of the first and second actions above occurring, without any needing any special anatomical training. The medial side meniscus (on the left side) is obviously pushed up completely out of a centered position, unlike the centered position on the lateral side. [SEE FIGURE 3.6 - OLD GRANT]

Elevated Shoe Heels Cause Knee Osteoarthritis

So, this abnormal rotary motion under extreme load is literally the force that alters the natural structure of the modern human knee. This is all according to Woolf's Law, which essentially says that structure of bone reforms itself in reaction to the forces placed on it, with the greatest forces having the greatest effect on the reforming process.

Unfortunately, the reformed structure of the modern knee is actually a deformed structure that leads directly to osteoarthritis, the most common form of arthritis, which most often attacks the human knee. The weak point is obviously the inner or medial portion, which is both extremely overloaded and the principal site of the unnatural horizontal rotary motion discussed above. The effect on the knee is exactly like a millstone grinding.

The is a very serious heath care problem. Nearly 60 million people are affected by arthritis in the U.S. alone, including more than half the population over age 65. The cost economically and in terms of the loss in quality of life is enormous. Neither cure nor prevention has been possible because the cause has not heretofore been know. Osteoarthritis will be discussed more later.

The Screw Home Mechanism Is Just an Abnormal Artifact of the Unnatural Outward Knee Tilting

The screw home mechanism is just an artifact of this abnormal structure that is formed under maximum stress when the knee is flexed, principally around 40 degree flexion. When the knee joint is no longer flexed but rather in the last 15 degrees of extension, the collateral ligaments of the knee both return to a relatively normal, balanced state of tension, instead of either too tight or too loose.

That allows the medial condyle of the thigh bone (femur) to return from its abnormal forward position to its initial, more centered position. But that position is no longer entirely natural, since the medial collateral ligament was very loose under load in the flexed position described above. So the fit is now tighter with a gradually shortened medial collateral ligament, causing an unnatural “close-packed” or locked position when the screw home mechanism is completed in full knee extension when the leg is straight.

A Clearer Understanding of the Knee Screw Home Mechanism

The screw home mechanism consists of the shin bone or tibia rotating to the outside relative to the thigh bone (or femur) during the last 15-20 degrees of extension and locking the knee in completely straight position. [SEE FIGURE 3.7 - DOUBLE KNEE DRAW]

In this locked position the shin bone and thigh bone are no longer lined up straight for load-bearing.

Instead, they are oblique to each other, as indicated by the position of the knee cap (or patella) and the patellar tendon, with the shin bone more to the outside. The is exactly the same relative position the knee is in when maximally loaded at 3 G's while running and the shin bone both rotated and canted out on the foot that has been supinated by an elevated shoe heel.

In this light, the solution to the longstanding mystery of the screw home mechanism is obvious. It is an abnormal, unnatural, and useless consequence of the abnormal modern knee structure and function created by shoe heels. As a frequent source of injury, it is a prime example of how shoe heels have made our bodies far less durable.

They also make our knees and entire legs much weaker.

4THE VASTUS LATERALIS, THE MAIN MUSCLE OF THE THIGH, IS UNNATURALLY WEAKENED

The vastus medialis is a thigh muscle attached to the medial or inside edge of the knee cap. It is the one of four quadriceps muscles that straighten or extend the leg. The vastus medialis controls the knee in the last 15 degrees or so of motion when it is being fully extended or straightened.

One of the leading authorities on the human knee has been quoted as saying that the vastus medialis muscle is the key to the knee[1]. As noted in the previous chapter, this last 15 degrees of extension is when the screw home mechanism controls the knee in an abnormal, unnatural locking motion. Therefore, is also seems likely that the critical role of the vastus medialis is also abnormal and unnatural.

Looking at the structure of the African knee, the vastus lateralis muscle located on the outside (of lateral portion) of thigh is typically much more developed. In star athletes, and especially common in black athletes, the vastus lateralis can be so highly developed that it almost creates a frog-leg look to the leg. [SEE FIGURE 4.1 - ESPN COVER]

This interpretation is supported by the almost identically developed vastus lateralis muscle of a nearly full term and apparently non-African human fetus. [SEE FIGURE 4.2 - KAPLAN '58] If anything, its vastus lateralis is more highly developed than that of a star athlete.

In comparison, the vastus lateralis of the normal Western knee is relatively atrophied. Such a knee must rely on the vastus medialis, as noted above, simply because of the excessive weakness of the vastus lateralis. This vastus lateralis weakness will be discussed more later.

A Remarkable Case Study Proves Vastus Lateralis Muscle Is Weakened By the Bow-Legged Position Caused by Shoe Heels

That this marked difference in muscle development is definitely not a racial difference is conclusively proven by happenstance in an extraordinary case study[2].

The case is of a young white male being treated for flat feet, presumably to relieve significant foot pain. Prior to surgery, he clearly has “knock-knees", the opposite of being bow-legged, with very highly developed vastus lateralis muscles. [SEE FIGURE 4.3 – SMILLIE BEFORE PIC]

Six months post surgery to make his thigh bones “normal”, he is bow-legged, with the characteristic relative wasting of specifally the vastus lateralis muscles. [SEE FIGURE 4.4 – SMILLIE AFTER PIC]

This case clearly proves that shoe heels significantly weaken the principal muscle supporting the knee, since they cause the bow-legged alignment that wastes the vastus lateralis muscle. Like the fetus above, it also proves conclusively that the difference in important thigh muscle size and shape is not racial, but instead a developmental effect of shoe heels, as we will discuss in more depth later.

The wasting effect on the vastus lateralis is continuous, extending over a lifetime, with the elderly showing the greatest relative effect of wasting[3].

It also explains why “White Men Can't Jump”, as noted in the Preface. More on this later. In addition, I think it also explains the accumulation in many women of cellulite on upper, outside portion of the thighs, the saddle-bags, in place of wasted vastus lateralis muscle.

5THE ANKLE JOINT IS ALSO ABNORMALLY RESHAPED BY SHOE HEELS

As you recall, the foot is forced into a tilted out, supinated position by elevated shoe heels. This poses an obvious question. Is the structure of the human ankle joint also changed like the knee joint has been by this abnormal foot position, which causes the lower leg (shin bone) to tilt out?

The easiest way to answer the question is to again compare typical ankle joints of primitive, barefoot populations with those of modern. The first example compares primitive Egyptian with modern European and shows an upper view of the ankle bone (talus), including the lower surface of the ankle joint, the trochlear[1]. [SEE FIGURE 5.1 - WOOD 114]

The most clearly apparent difference is that trochlear surface (in white) of the primitive Egyptian has essentially a regular rectangular shape. This shape is compatible with being a simple hinge joint.

The modern European's trochlear surface has a similar shape, but differs significantly in that it is angled to the outside. This difference logically can be explained as a reshaping to accommodate the abnormal motion of the shin bone being tilted to the outside by elevated shoe heels.

Another comparative example is that of a primitive Australian aborigine, which again shows clearly an ankle joint with a trochlear having essentially a regular rectangular shape, indicating a simple hinge ankle joint like that of the Egyptian[2]. [SEE FIGURE 5.2- WOOD 23]

While the primitive ankle joint is simple and regular, the modern ankle joint is irregular and much more complicated in structure, given its abnormal functioning dictated by the unnatural supination position of the modern foot.

Like the primitive knee joint, the shape of the primitive ankle joint is regular, with sides that look symmetrical. In contrast, and like the modern knee joint, the shape of the modern ankle joint is irregular, with asymmetrical sides.

The Irregular Shape of the Modern Ankle Joint

The modern ankle joint has a lateral side with an articular surface all of which coincides with part of a circle having a constant radius. This suggests that the supination/tilting out mechanism has not affected the lateral side of the modern ankle joint[3]. [SEE FIGURE 5.3 – NAPIER]

The modern ankle joint's medial side surface is different, asymmetrical. The rear portion of the medial articular surface coincides with part of a circle having a larger radius than that of the lateral side. The forward medial portion coincides with part of a circle having a smaller radius than the lateral side.

The reason for this rear versus forward difference is as follows. Load-bearing is increased on the rear lateral portion with the larger radius when the foot and ankle are in the abnormal supination-tilting out position. In that tilted out position, the medial side of the ankle joint would be under reduced load,

since the force of body weight has been redirected laterally by simple physics and geometry. By Woolf's Law[4], the lack of pressure on the medial side allows bone growth, increasing the circle radius on the medial side.

In contrast, an increase in pressure would be required to retard bone growth in the medial ankle joint's forward portion with the smaller circle radius. The unnatural foot supination/tilted out position of the lower leg (shin) bone somehow creates this abnormal increase in pressure on the forward, inside portion of the medial ankle joint, instead of on the lateral .

At first this is very puzzling. Why does location of the load-bearing shift from primarily on the outside of the rear of the ankle joint to the inside of the front side?

The Cause of the Paradoxical Shift in the Shape of the Ankle Joint's sides

This gets fairly complicated, but the change in shape is due mainly for the following two reasons.

First of all, as noted earlier, maximal vertical ground reaction force occurs during running when the knee is flexed and the lower leg bone is bent as far forward as it goes. This is called a maximum dorsiflexion position of the ankle joint.

In this ankle joint position, with the lower leg maximally tilted out abnormally, the ground reaction force has an abnormal horizontal ground reaction force component. That abnormal force component is essentially in the frontal plane, pointing in a direction directly to the inside.

That abnormal horizontal force component direction is virtually the same direction that the subtalar ankle joint is moving at the same maximally loaded stance position of the running stride. That is, when the subtalar ankle joint is maximally pronated during running, it is subjected to an unnatural additional inward sideways force that increases pronation abnormally.

That abnormally increased pronation increases the load on the medial or inner side of the forward portion of the ankle joint, as indicated by it retarded structure noted above.

The Centuries-Old Misunderstanding of the Squatting Facets of the Ankle Joint

This pronation increase caused by the unnatural supination/tilting out mechanism is further reinforced by the absence of a natural stability mechanism, which is the second reason. The absence is caused, again, by elevated shoe heels.

On the upper surface of the ankle bone (talus) of all primitive, barefoot racial populations (including Neolithic Europeans[5]), it is very common to find what have always been call “squatting facets”. These squatting facets essentially look like extensions of the ankle's upper joint surface (the trochlear). They can be located mostly on the inside, or the outside, or even include middle portions.

The accepted and completely settled explanation for their existence is that they are created to accommodate the habitual squatting position that is almost universally adopted by these primitive barefoot populations, which lack chairs to sit on in addition to lacking modern footwear. [SEE FIGURE

5.4 – SQUATTING PIC FIG. 1 FROM H CHARLES]

In the squatting position, the lower leg (shin bone or tibia) naturally moves as far forward as it can go. The forward motion is limited by the structural limit of the ankle joint. This position is called maximum dorsiflexion of the ankle joint.

That forward limit is reached when the lower portion of the tibia physically engages the upper neck of the talus. The abutment of the two bones of the ankle joint together creates the aforementioned squatting facets on the neck of the ankle bone.

But squatting doesn't cause the facets, barefoot running does. If you refer back to Figure 3.1 [SEE FIGURE 3.2 - Muybridge/Ryun] remember that the maximum vertical ground reaction force at about 3 G's occurs during the running stride in exactly the same, fully dorsiflexed ankle joint position.

Again, the maximum regular forces that the human body encounters occur during running. By Woolf's Law, the maximally-loaded position of the barefoot running stride is the fully dorsiflexed position in which the ankle joint is shaped. Squatting plays at best a very minor role because the forces involved are very low then.

So, these are definitely barefoot running facets. Their presence is indicative of the key stability role played by the fully dorsiflexed, locked ankle joint position of the runner's leg just when maximum running load occurs. This position is effectively the position in which the human suspension system bottoms out and when the human body is shaped by maximal forces.

The Renamed "Barefoot Running Facets" Stabilize the Knee When Running

The barefoot running facets are the forward endstop for the front of the ankle joint, serving to limit its forward motion in an efficient, structural way that minimizes muscular effort.

The fully dorsiflexed, foreward-locked ankle joint position provides a critically stable and efficient base for the runner's leg. Because it stops the forward motion of the lower leg (tibia), it also effectively reinforces the action of the thigh's quadriceps muscles to end the knee joint flexing that occurs to absorb the body weight force of landing. And it does so without any energy cost!

It is well known from prior studies that wearing conventional shoes with elevated heels causes the knee to flex more than when barefoot. This is because with such shoes the stabilizing base of the fully locked ankle joint of the barefoot is entirely missing.

With shoes, the tibia never abuts against the talus, so there are no "squatting" or "running" facets on the ankle bone of the modern foot.

The functional results are not good. Because the stabilizing base of the locked lower leg is gone with conventional shoes, the quadriceps muscles obviously must work harder than is natural.

But that's not all. The muscles on the back of the lower leg, the solius and gastrocnemius, must work harder than is natural to stop the dorsiflexion action of the ankle joint. That abnormally increases the

strain on the achilles tendon and shortens it unnaturally.

The unnatural strain on the achilles tendon and on the quadriceps sets up a big part of the transition problem (going from barefoot to shoes or to shoes with different heel heights) touched on earlier. That problem will be discussed in more detail later.

The Puzzling Backward Angle of the Base of the Barefoot Runner's Knee Joint

This seems like the right point at which to digress slightly in order to clear up another long-standing misconception about another major joint of the lower leg anatomy typical of the primitive, barefoot population. It's directly related to the misunderstood squatting facts discussed above.

It has puzzled researchers from the Nineteenth Century until now why the primitive lower leg bone is slightly bent backwards, with the lower surface of the knee joint, the tibial plateau, tilted backwards at an angle about 5 degrees more than the modern knee[6]. In the few examples I have found in published studies, the angle looks greater, more like at least 15-20 degrees. [SEE FIGURE 5.5 – Q.W. FIG. 6]

Again, the cause was thought to be the squatting habit of primitive barefoot populations. In contrast, the modern tibia is straighter and the knee's tibial plateau is closer to horizontally oriented. [SEE FIGURE 5.7- OLD GRANTS 303]

The answer to this puzzle about what is called tibial retroversion is strongly suggested by again referring back to Figure 3.2. [SEE FIGURE 3.2 - Muybridge/Ryun] Specifically to the lowest stride position shown there, when the body's suspension system has bottomed out under maximum load, with maximum knee flex.

Tibial retroversion of the normal primitive shin bone is further confirmation that this flexed knee position is the most important leg position in molding the structure of the human body, not the relatively straight leg of standing and walking.

In that maximally loaded and flexed knee position, the tibial plateau of the barefoot runner's knee would be roughly horizontal. That horizontal position would seem like the most stable load-bearing position in which for the base of knee to be. It is natural and also much closer to the fetal angle.

In the same maximally loaded and flexed running position, the modern tibial plateau is tilted forward. But in that structurally much less stable position when running, the condyles of the thigh bone of the modern knee must be held in place on the tibial plateau by the knee ligaments and muscles.

The ligaments and muscles must work harder to resist the powerful forces acting on the condyles to slide forward when the runner's knee is flexed. And they must resist them with less natural direct bone structural support than the primitive runner's knee.

Another common structure among the same primitive barefoot runners is called tibial retroflexion. In retroflexion, the shin bone or tibia itself is slightly curved backwards. That has exactingly the same effect as tibial retroversion in that the tibia plateau is tilted backwards when standing upright and

horizontal under max load in the flexed knee running position. [SEE FIGURE 5.6 – Q.W. FIG. 11 RETROFLEXION]

Like tibial retroversion discussed above, tibial retroflexion of the normal primitive shin bone is further confirmation that the flexed knee position of Figure 3.2 is the most important leg position in molding the structure of the human body, not the straight leg of standing and walking.

A Different Ankle Joint Axis for Dorsiflexion and for Plantarflexion

Getting back to the irregular shape of the modern ankle joint, that abnormal shape is associated with a different axis for the dorsiflexion in the front of the ankle joint and for plantarflexion in the rear. Each axis is located in the frontal plane. In contrast, the more simple primitive ankle appears very regular, with just one ankle joint axis.

In dorsiflexion the modern ankle joint axis slopes downward to the outside. In plantarflexion it slopes downward to the inside.

The logical explansion for this abnormality would seem to be this. As previously discussed, when elevated shoe heels plantarflexes the ankle joint, that backward motion automatically supinates the foot and ankle joint. That unnatural supination rotates the foot to the outside, raising the inside of the foot and ankle. By doing so, it also rotates upward the position of the planterflexion axis to a more level position for the ankle joint, which allows it to function more normally in its abnormal position.

Also as discussed previously, the elevated shoe heels exaggerate pronation, forcing the ankle joint downward during dorsiflexion. By doing so, it also rotates downward the position of the dorsiflexion axis to a more level position for the ankle joint, again allowing it to function more normally in a different abnormal position.

Xray Confirms Varus Position of the Front of the Subtalar Ankle Joint

A very recent study[1] of the configuration of the subtalar ankle joint appears to add to the confirmation of the basic thesis of this book. That is, that elevated shoe heels force the foot into an unnatural supinated position, tilted to the outside. The more the ankle and knee joints flex under increasing load when running, the farther to the outside the lower leg bone is tilted to the outside.

The really interesting, even surprising thing is that this clear and definite orientation to the outside is fixed throughout the forward motion or dorsiflexion of the ankle joint. Amazingly, it is fixed to the outside in supination even if the foot is forced to pronate excessively in reaction to the excessive unnatural forces described above.

The study's example xray of the subtalar joint taken in an anterior (front) part of the joint shows this clearly in the varus orientation of the surface of the joint[7]. [SEE FIGURE 5.8 - FIG. 4 OF COLIN] The extremely dense trabecular bone structure on the lateral half of the joint provides further confirmation in actual bone structure.

This dense structure indicates the excessive, unnatural force to which it has been subjected, by Woolf's Law. Again, this lateral tilting-out is all happening because of running in elevated shoe heels.

All the Basic Foot Types of Modern Runners Have Tilted-Out Lower Legs.

All modern humans are affected by this unnatural problem. Pronating runners with flexible feet, supinating runners with rigid feet, and normal modern runners in between, the lower legs of all are tilted-out during the landing and first 30 milliseconds of stance. [SEE CAVAN Fig. 11]

One of the earliest pioneers of modern running research, Peter Cavanaugh, discovered this in a study published in 1987[8]. So whether the foot pronates excessively or never pronates at all (and instead rotates to the outside in greater supination), in all cases the lower leg is tilted-out abnormally.

In a different study[9] at the same time, another of the early pioneer, Benno Nigg, noted that the cases of runners who either pronate excessively or supinate excessively are unnatural. Those excessive motions occur only when running in modern running shoes, not barefoot.

Elevated Heels Cause Your Shoes To Wear Most On the Rear Outside Edge of the Heels

Your foot is always unnaturally supinated when it is landing during walking or running, so you land on the outside edge. Since elevated shoe heels unnaturally project downward below the level of the shoe wearer's foot sole when landing, it follows logically that the artificial heel projections must hit the ground first.

But not only your shoe heel is affected by this artificial supination tilting-out. The heel bone (calcaneus) of the modern foot has a small bone protrusion at about the same spot.

It is called the lateral calcaneal tuberoscity and it is not present primitive barefoot Africans[10]. [SEE FIGURE 5.9 - WELLS 225]

The fact that the foot is generally made more rigid when it is in the shoe heel-induced supination position would function to increase stress at the lateral calcaneal thereby causing an unnatural lateral calcaneal tuberoscity, as well as increasing lateral shoe heel wear, as noted above.

Elevated Heels Project Downwardly When Landing, Automatically Forcing Runners to be Heel Strikers

That's why nearly all runners wearing modern running shoes land heel first, technically called heel striking. That has to happen even if the modern shod runner's foot sole itself is actually perfectly level when landing, because of the abnormal downward projection of the elevated shoe heel, which inherently extends closer to the ground than the non-elevated forefoot of the shoe sole.

Human Evolution Indicates Nurture, Not Nature, Has Altered the Ankle Joint

For many decades the fossil record has been clear. The available ancient ankle bones going back several million years, from the famous Lucy fossil discovery[4] to the most recent discovery of many

Homo naledi fossils[5], all are similar to the simple ankle joint structure of primitive barefoot populations. The Homo naledi talus even has obvious “squatting” facets. [SEE FIGURE 5.10 - NAT GEO] [& LUCY] [COMPARE TO OLD GRANTS]

Given the critical survival nature of locomotion to our human precursors, it seems beyond doubt that the unbroken continuity of the simple, “primitive” structure of the barefoot ankle joint is absolutely baked into our genes as a firmly fixed natural trait.

Still, it is theoretically possible that the structural difference between modern and primitive barefoot ankle joint are a racial variation based on genetic differences. But those genetic differences would have to have evolved in an amazingly short period of time, just thousands of years.

Even in the absence of all the incriminating evidence relating to shoe heels already uncovered (with more to come), it seems virtually impossible for evolution to have produced the substantial change in modern ankle joints.

Other Mammals Appear to Have Parallel Sided Ankles Too

I don't know if any similarly detailed studies have been done for mammals that are as detailed as those for humans discussed above. I've guess there are not, so I haven't made time to try to do comparative research on the ankle bones of other mammals.

The is however a classic study by Hildebrand in 1960 on how animals run. Its drawings indicated that the precursors of modern mammals had what appear to be parallel sided ankle bones (that is, the trochlear joint surface). Modern cheetahs and deer appear to as well.

Horses appear to as well, but the joint is slanted somewhat, so it is less clear. Perhaps less relevant as well, since horses run on hooves that are actually the toenail of their middle toe, so the structure of their lower extremities has evolved in a much different manner than that of humans.

6THE FOOT IS ALSO ABNORMALLY RESHAPED BY ELEVATED SHOE HEELS

By now you would not be surprised to find out that elevated shoe heels have also changed the overall shape of the human foot. As measured by a footprint, the modern foot clearly indicates the unnatural shift, rolling to the outside, that is characteristic of its abnormal supination in contrast to the primitive, barefoot foot[1]. [SEE FIGURE 6.1 – JAMES FIG. 3 1391]

Proof that this difference is unnatural and caused by conventional modern shoes with elevated heels is indicated in the same Lancet study, which compares the footprints of a native Solomon Islander with a European who had never worn shoes. The two footprints are nearly identical, clearly indicating that different races is not a factor. [SEE FIGURE 6.2 – JAMES FIG. 6 1392]

As indicated previously, the abnormally supinated modern foot with tilted-out lower leg perversely creates a strong horizontal force component during stance that rolls the foot to the inside in a pronation motion.

This force is great enough that it shows up even in walking, wherein all forces much less than in running. The result is to move peak pressures from the middle of the forefoot in the barefoot to the inner edge, focusing on the big toe (the hallux), in conventional daily footwear[2]. [SEE FIGURE – D'AOUT S119

This focus of peak pressure on the big toe causes a condition called “hallux valgus”, which is a lateral deviation of the big toe. It is the most common orthopedic problem of the normal adult foot in shod populations, but exceedingly rare in barefoot populations[3] [SEE FIGURE 6.3 – MAYS FIG. 4]

Again, this is not a racial difference. Hallux valgus was not common in medieval France, became common in the 16th and 17th centuries in males (the early high heel adopters then, until the French Revolution), and since has been most common in women, especially so in contemporary times, now that relatively extreme high heels are common[4].

Are the Basic Motions of Pronation and Supination Missing in the Primitive Barefoot?

One of the most significant studies I have found is an old one referred to earlier[5.] It describes a typical primitive African barefoot as being turned in slightly (pigeon-toed). There is no eversion of the foot during walking stance. The foot sinks down 'on an even keel' due to a flattening of the main arch.

The modern European foot is different. It is turned out about 20 degrees, with slight eversion, and with the lateral main arch remaining rigid and not supporting weight directly, instead sending it to the heel and forefoot.

This difference suggests that the whole range of modern foot stance motion is abnormally exaggerated from supination to pronation. It may be only an unnatural characteristic of the modern shod foot, tilted-out and made more rigid by elevated heels.

7ELEVATED SHOE HEELS TILT OUTWARD THE THIGH AND HIP JOINT

It should be no surprise at the point that elevated shoe heels tilt the thigh outward. After all, shoe heels tilt out the tibia, to which the thigh is directly connected at the knee joint.

The hip joint connects the thigh bone to the pelvis. It is a ball and socket joint, which allows it to enable motion in all three planes. This is unlike the knee joint, which is more like a hinge joint, at least in its natural state.

The range of motion of the hip joint reflects the conclusion that it has developed abnormally to accommodate the unnaturally tilted out thigh bone.

Referring to Figure 7.1, it appears that the whole range of hip motion is rotated to the outside. Even more telling, the central axis of the hip joint (F_2) is clearly rotated to the outside. [Kapandji Fig 30]

The abnormal development of the hip joint is clear when you compare the front of the hip joint, Figure 7.2, with the back, Figure 7.3. [OLD GRANTS 242-3]

What you see in Figure 7.2 is that the ball head of the femur (or thigh bone) is substantially exposed in front, not covered by the acetabulum, the joint socket located in the pelvis and which holds the ball head. In Figure 7.3, you see the opposite in the back, the ball head is rotated far inside the socket, more than completely covered by the acetabulum.

In Figure 7.4, a more detailed front view, you see similarly that the ball head of the femur is not even covered by the ilio-femoral ligament. In contrast, the ball head is completely covered by the ligament in the parallel rear view of Figure 7.5. [OLD GRANTS 274-5]

The Hip Joint Incongruence is Incorrectly Blamed on Evolution

This obvious lack of critical joint surface congruence cannot be natural or effective biomechanically. Like the ankle and the knee, the inherent weakness of the modern human joint design is blamed on evolution.

Specifically, it is blamed on the bipedal, upright posture of the human body, especially during locomotion. Although it is true that this upright posture is unique among mammals, it is not a recent development that is still a work in progress.

As pointed out earlier, the enduring shape of fossil ankle bones indicates a tried and true design, not an unfinished, jury-rigged set-up. The same is true of the primitive barefoot knee.

The accepted current explanation for the apparently poor design of the hip joint is that it is designed for locomotion on all four limbs, just like all the other mammals. In other words, the bipedal human body has just incompletely evolved from its original quadruped state.

Therefore, the accepted explanation goes, when the human body is repositioned into its former

quadruped position, the ball and socket once again become correctly aligned in their more natural state. This explanation is illustrated in Figure 7.6. [KAPANDJI 38-9 &41-4]

Evolution Is Not the Explanation for the Hip Joint Incongruence, for Two Reasons

Although plausible, that explanation is wrong, because, first, as already shown in this chapter, elevated shoe heels rotate the femur outwardly, as already shown in the modern hip joint of Figures 7.1-7.5.

Second, just like the knee, the design of the bipedal hip joint is shaped by the maximum forces to which it is subjected routinely. That is the flexed knee and flexed hip position of the midstance running stride shown previously in Figure 3.2.

In that maximally loaded midstance running position, the ball head of the femur and the acetabulum socket of the pelvis are correctly aligned. Nevertheless, they are unnaturally in a rotated out position caused by elevated shoe heels.

Nature is not at fault. Our shoe heels are.

8SHOE HEELS TILT THE PELVIS UNNATURALLY BACKWARDS

The natural position of the pelvis has been substantially altered by the elevated shoe heels of modern shoes, as you might guess by now. But you probably would not be able to guess how.

Here is how. I stumbled across it in one of the oldest modern studies of running, "The Biomechanics of Running", published in 1962 by an M.D., Donald Slocum, and Bill Bowerman, the famous track coach of the University of Oregon and one of the founders of Nike.

What they pointed out was that the pelvis automatically rotates forward in the sagittal plane (front to back) when the thigh and foot rotate inward in the horizontal plane. And vice versa, when the thigh and foot rotate outward, the pelvis automatically rotates backward. Inward rotation of the pelvis increases the curve of the lower (lumbar) back and outward rotation decreases the curve, causing a flatter position of the lower back.

You Can Do This Simple Confirmation Test

Bowerman and Slocum pointed out that you can confirm for yourself this direct connection between pelvis tilt and thigh/foot rotation with the following simple test:

> Stand in the normal erect position with the weight on both feet, then lift the right foot just above the ground. Now roll the pelvis forward (clockwise as seen from the right side), throwing the lumbar spine into the lordotic position; note the increased internal and decreased external rotation of the hip as demonstrated by the rotation of the foot. Next, roll the pelvis backwards to the flat-backed position and observe that the range of external rotation is increased materially while internal rotation is decreased correspondingly.

Of course, Bowerman and Slocum were not researching the affect of elevated shoe heels on the natural biomechanics of human running. Far from it. A few years after the study, Bill Bowerman became one of the leading originators and popularizers of modern running shoes, starting with the Nike Cortez model, with many others following – and all with elevated heels.

The Backward Tilted Pelvis Causes an Unnatural Flat-back Position

What they missed completely was, as I have already discussed, that elevated shoe heels cause the foot to supinate and lower leg to rotate outwardly. Since the lower leg obviously connects directly to the thigh at the knee joint, the thigh is also forced to rotate outwardly when running, automatically activating the rearward rolling of the pelvis into an unnatural flat-backed position.

So, to recap, the outward rotation of the thigh causing a backward rotation of the pelvis and flat-back was described by Bowerman and Slocum as normal and therefore desirable in running. Instead, it is in fact an abnormality caused by shoe heels, and therefore highly suspect of creating unnatural problems. A more recent study has confirmed the relation the explicit relationship between elevated shoe heels

and backward pelvic tilt[1]. [SEE FIGURE 8.1 – BENDIX FIG. 7]

The Backward Tilted Pelvis Causes Heel Footstrike!

There have been many papers in the past few years on footstrike. The issue discussed primarily is whether a forefoot or midfoot position is more natural when the foot hits the ground when running than the heelstrike that is common with modern running shoes.

Slocum and Bowerman noted that the flat-back position of the spine when the pelvis is rotated backwards results in a backward shift in the body's center of gravity so that the body weight falls more toward the heels. They considered this desirable. Like the flat-back position, they interpreted an abnormal condition to be normal.

The Iliotibial Tract Connects the Tibia to the Iliac Crest of the Pelvis

Before moving onto the problems, we need to get back to the iliotibial tract. The iliotibial tract is a super-long ligament connecting the outside edge of the uppermost tibia (shin bone) to the iliac crest, the upper rim located on the outermost side of the pelvis. [SEE FIGURE 8.2 – OLD GRANTS OR ?]

Unmentioned by Slocum and Bowerman, the iliotibial tract plays the critical role of connecting the lower leg (and therefore, the foot too, through ankle and subtalar joints) with the pelvis.

The connection is by ligament, not muscle, so the mechanism happens automatically, without muscular control by the thigh muscles. In an important sense, the thigh is passive and just goes along for the ride.

The control comes from the elevated shoe heels shifting the subtalar ankle joint outward, rotating the ankle joint and tibia outward, and thus the pelvis backwards, all because of the iliotibial tract connection.

The Unnatural Backward Tilt of the Pelvis Causes the Hamstring Muscles to Abnormally Tighten and Weaken

As mentioned previously, elevated shoe heels directly cause the muscles on the back of the lower leg to tighten abnormally. They also cause the muscles of the back of the thigh, the hamstrings, to tighten because of the backward tilt of the pelvis.

The tightening happens because the top of the hamstrings is attached to the ischial tuberosity of the pelvis (the bottom of the hamstrings connect to the top sides of the tibia). So when the pelvis is tilted backwards by shoe heels, the ischial tuberosity moves closer to the tibia. [SEE FIGURE 8.2 – HAMILL # FIG.6-14 D]

Bringing the upper and lower hamstring attachments closer together automatically shortens their range of motion, which tightens them abnormally. It also weakens them through disuse, or more specifically in this case, less use.

The weakening occurs as a result of the same motion, since the hamstring muscles are not having to work to bring their attachments together. So they do not strengthen naturally. They are brought partially together automatically by the unnatural backwards pelvis motion.

9THE ABNORMAL FLAT-BACK CAUSES AN UNNATURAL FLAT-BUTT

The same shoe-heel induced backward tilt of the pelvis also causes the gluteus maximus muscle to weaken. Its upper, inside attachment is to the iliac crest of the pelvis down to the lower part of the sacum (the base of the spine that joins the two pelvis halves in the rear and the coccyx below it. [SEE FIGURE 9.1 AND 9.2 – OLD GRANTS OR ?] Its lower, outer attachment is the femur and iliotibial tract.

The effect of the backward pelvic tilt on the gluteus maximus is roughly twice as bad mechanically as it is on the hamstrings. The adverse effect is so magnified because both attachments are moved automatically toward each other.

The shoe heel simultaneously rotates the tibia out (together with the iliotibial tract attached it) and rotates the pelvis backwards. Essentially this rotation occurs due exclusively to the mechanical interaction of elevated shoe heels, bones, and ligaments. The unnatural mechanical interaction is being powered by the bodyweight force of gravity, not by force generated by muscles.

My best estimate is that the epicenter of the muscle weakening is the coccyx, meaning that the relative motion of the gluteus maximus muscle attachment is greatest at the coccyx and its counterpart on the iliotibial tract. In other words, the gluteus maximus muscle works the least hard at that location, in a relativesense.

So here is the net effect. The coccyx would be the pelvic bone that projects rearward the farthest, but it is rotated in the most.

And the development of the gluteus maximus muscle is significantly reduced, with the reduction centered around the coccyx and fanning out to the sides. The unnatural result is an abnormally flat-back and an abnormally flat-butt, directly below it.

Most would agree that this change has a disagreeable aesthetic effect. However, the functional and structure effects go far beyond aesthetics. In fact, the unnatural flat-butt has dire effects that cascade throughout the entire body, affecting almost every part.

For starters, just like the backward tilting pelvis effect on the gluteus maximus was twice as great as the effect on the hamstrings, the effect of the flat-butt is doubly magnified, as we shall see in the next chapter.

10THE ABNORMAL FLAT-BUTT RESULTS IN AN UNNATURALLY SOFT BELLY

The double magnification comes from the fact that muscle groups work in tandem over a joint, like the front and back muscles of your legs. They are antagonistic to each other, meaning when one muscle group extends the joint, its antagonist group does the opposite and flexes that joint.

In a direct sense, the two muscle groups work against each other. And the development, or lack thereof, of one group directly effects the muscular development, or lack thereof, of the other.

There should be a natural balance between a pair of antagonistic muscle groups. In fact, there has to be. If there is not, the weak muscle group tends to become injured, particularly under repetitive stress.

For example, it is pretty well established now that relatively strong quadriceps paired with relatively weaker hamstrings leads to hamstring muscles pulls, particularly on the weakest leg.

In this case, the antagonistic muscle group is the abdominals, primarily the rectus abdominis. But the problem is much more that just that the abdominal muscles are paired with an abnormally weak muscle group led by the gluteus maximus.

The biggest problem is that the automatic backward tilting of the pelvis has essentially the same effect on the abdominal muscle group as it does on the gluteus maximus. That is to say, the backward tilting moves the upper (rib) and lower (pubic) attachment points of the rectus abdominis automatically closer together.

This happens at the midstance, maximally loaded position in running when the abdominal muscles would normally be fully activated to absorb the peak force of body weight. The result again is a severely weakened muscle group.

Lack of Primitive Barefoot Population Evidence Forces a Slightly Different Methodology

Unfortunately, I haven't located comparative information from studies of primitive, barefoot populations relative to the flat-back, flat-butt, and soft belly characteristics of the modern human body. Bones and fossils leave a physical record to analyze that muscles do not. So is it impossible to figure out directly what structure and function that backs, butts, and bellies that have not been altered by shoe heels should have?

There is however a fall-back approach. I believe it is a reasonable assumption to make that athletes who are exceptionally gifted and durable physically are likely to be very close to the natural primitive norm of a body undeformed by modern shoe soles with elevated heels. At any rate, they are the closest we have without new field studies.

There are some additional arguments to support that reasonable assumption, but they fit better into another topic we will get into later. So for now, just listen to where the reasonable assumption can take

us.

Two Famous Athletes Who Were Absolute Physical Phenoms Shared a Key Trait: Rock-Hard Abs

The two athletes are Hershel Walker and Michael Jordan, both of whom unquestionably stood well above their peers at the collegiate and professional level and did so for a long time. The key physical trait they shared is phenomenally developed abdominal muscles.

Hershel Walker was well-known for having grown up on (and maintained) a training regime that focused on doing almost unlimited sit-ups. Michael Jordan had exceptional six-pack abs, as you can verify in the movie, **Space Jam**.

To digress slightly to emphasize that point, Michael's abs were so exceptionally tight that during college he was cut slightly on the stomach by a sword-wielding showman in a surprising accident. The swordsman routinely placed watermelons on the stomachs of volunteers. Then with great flourish he sliced the watermelon in half without harming the volunteers. The swordsman's technique worked flawlessly until Michael, but no one knew until then just how unusual his abs were.

Oddly, the most popular texts on biomechanics and kinesiology, which seem excellent in every other way I can discern, have little text and no figures focused on the abdominal muscles. I thought that there has been a fair amount of attention in recent years generally in developing and maintaining a strong “core”.

At any rate, since as I have shown, shoe heels have the effect of weakening the abdominals, we will return to this important issue later.

11MAJOR MISALIGNMENT: BOTH FEET AND BOTH LEGS TILTED OUTWARD, ROTATING THE PELVIS BACKWARDS

Summarizing what happens when we run, because of elevated shoe heels, each foot is tilted to the outside. Instead of straight ahead, each foot is pointed in a different direction. The right foot to the right of center and the left foot to the left of center.

As a result the unnatural foot position, each leg is tilted to the outside. each leg is also pointed in a different direction and each different direction not straight ahead. The abnormal position of both legs rotate the pelvis backwards.

All these abnormalities together present a serious misalignment problem. Each leg is headed in a different direction, but both are connected together by the pelvis. How does the body cope? What happens?

Your Body Has A Major Front End Misalignment That Causes Unnatural Breakdowns and Accidents

Imagine for a minute this crude car analogy, where your legs and pelvis are the front end of the car. Your legs are the wheels and suspension, and your pelvis is the rest of the front end of a car. Because of elevated shoe heels, your front end is not correctly aligned, to put it mildly. It is splayed out abnormally.

In effect, each wheel has over-inflated tires (like your abnormally supinated foot is unnaturally rigid) and is also tilted-out to wear on the outside edge of the tire. In addition, each wheel is pointed in a different direction to the outside, not straight ahead. [SEE NEW FIGURE]

It is easy to forecast what will happen. Your car's wheels, suspension, and front end will wear out quickly, unless they cause an accident first. Break-down or accident, those are inexorably the only two possible outcomes. The car will never make to anywhere close to its warranty mileage.

Compared to a car, your body is a far superior and much more accommodative biological machine. But the result is the same in the end, if more subtle. Just a slower breakdown over a longer period of time.

In short, then, elevated shoe heels create abnormal body structures that cannot work together as a complex, interrelated system in a natural way. They can only cause an early, unnatural breakdown, both more rapidly and in abnormal ways.

12BOW-LEGGED BOYS ARE TYPICAL DUE TO SHOE HEELS

[LINE SPACING PROBLEM FOLLOWING IN THIS CHAPTER] *FIXED?????*

There is good evidence that there are two basic ways in which your body must breakdown structurally in response to your fundamentally misaligned front end.

The first way is as just described above, which is most typical in males, is with both knees bent out into a bow-legged position. Although created beginning early in life primarily from running, the bow-legged stance manifests itself also when walking or standing because the typically male leg bones become structurally molded into that position permanently.

The medial or inside portion of both of the typically male knee joints is under abnormal, excessive pressure, which retards bone growth. The lateral or outside portion of the male knees is under abnormally light pressure, which stimulates bone growth. All this according to Woolf's Law.

A Wide Spectrum of Variation in the Angular Degree of Typical Male Bow-Leggedness

The result over time is that typically both male knees tend to become permanently bent out into a classic bow-legged position. As a general rule, this is the structural state of most modern males, although the amount or angle of bow-leggedness varies widely. There is a wide spectrum of variation in the amount of typical male bow-leggedness, depending on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any particular individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

One noteworthy male characteristic resulting from being in a sense pushed into this abnormal position is that it contributes to a further stiffening of male joints, which are already less flexible than those of women (by reproductive design). This is because being pushed unnaturally in one direction only repeatedly gradually reduces the range of motion of the involved joints in the opposite direction.

Thus, the abnormally rigid foot created by the unnatural supination induced by elevated shoe heels causes further rigidity everywhere else in the male body, but particularly in the lower back because of the backward rotated pelvis. More about this later.

The Principal Unique Factors Behind the Male Type of Breakdown Are Relatively Low Heels and High Activity

The principal factors that create this typical male state are relatively low elevated shoe heels and relatively high activity levels. Many studies confirm that boys are more physically active than girls[1]. And, generally among males, high heels are relatively uncommon, except among cowboys.

By the way, the best historical information is that elevated heels were apparently invented by Asian horsemen, who used them to anchor their feet more securely in stirrups[2]. This is almost comically ironic now in hindsight.

Cowboys archtypically have bowlegs, commonly thought to be the result of endless long days riding in the saddle with legs bowed in around the body of the horse the better to keep from falling off the horse. Perhaps that is a minor factor, but like the most famous Nike ad about Michael Jordan's superhuman performance, it is not the horse; instead “it's the shoes!” In this particular case, the cowboy boots.

There is another factor relative to the amount of bow-leggedness: luck. Luck in the form of genes, which is whatever is an individual personal natural disposition toward developing bow-legs. That is currently an unknown that we will discuss later.

Accidents Like Ankle Sprains Are Another Major Factor In the Development of Bow-Legs

The other form of luck besides genes is accidents. Because of shoe heels, body structure is weaker than natural and therefore prone to unnatural damage that can profoundly effect the development of an individual's body afterwards.

For example, one of these weaknesses is unnatural ankles. Elevated shoe heels have supinated feet generally, tilting or rolling ankles to the outside (or laterally) exactly in the same direction of most ankle sprains. And lateral ankle sprains are by far the most common sports injury and also the most common injury requiring Emergency Room visits (although most sprain ankles go without any proper professional treatment).

These acute injuries were once dismissed as generally temporary. But studies now are making it increasingly evident that at least many (or perhaps even most) of these injuries are leading to chronic, permanent injuries. We will get back to this later.

The Transition Back to Barefoot Running Has Become Difficult If Not Impossible for Most

As noted above, because of Woolf's Law, the abnormally bent out legs and backward tilted pelvis caused by elevated shoe heels gradually rebuilds our skeleton over time into this unnatural structure with abnormal function.

Each individual person has their own set of factors that has altered their own unique personal structure. It can be fairly close to natural with relatively normal function. However, their own personal structure can also be at the other extreme, highly unnatural with very abnormal function. Or somewhere in between the two extremes. There are additional complications we will discuss later.

But if you have more than insubstantial structural changes it is impossible to transition back to the natural, barefoot condition simply by removing your shoes. The reason is that the abnormal shod structural state has become the artificial new norm for you.

The sad reality is that you have become dependent on elevated shoe heels to maintain the abnormal alignment that has become baked into your anatomy. For example, if your legs have been remolded into a bowed position by shoe heels, removing the heels will not change that.

Moreover, removing the heels will now create unnatural pressure on the outside or lateral portion of your knee, just as surely as putting on elevated heels originally created unnatural pressure on the inside or medial portion of your knee.

In a figurative sense, most of us have inadvertently painted ourselves into a corner by wearing modern shoes with elevated heels. In fact, I think our collective situation is even worse than that.

Switching from Higher Heels to Lower Heels or Barefoot Causes New and Different Injuries

The first part of the bad news is that you have already switched back and forth almost randomly throughout your life between higher heels, lower heels, and no heels, as noted earlier. So you are already locked into the additional but opposite structural problem discussed immediately above caused by removing the unnatural support of elevated shoe heels.

The second part is actually worse. As best I can determine from the limited available evidence, reducing or removing the unnatural shoe heels after your body has been remolded to them causes something like a structural collapse inward of the many interconnected but misaligned parts.

In terms of your body, it is sort of like building it into a house of cards and then removing one, causing the whole structure to collapse.

This reaction of inward collapse is inherently complicated due to the massive complexity of the human body. And being unknown until now, it has not been formally researched at all. So it is not possible for me to describe it to you in simple terms, even to the limited extent I understand it at this early stage.

But because we have all already done this switching back and forth, it is possible to describe the apparently related effects on the body that have been researched. The short answer is that substantial asymmetries are created between the right and left sides of your body making them unnaturally different. And these asymmetries cause new and different problems beyond those simpler, relatively symmetrical ones we have already discussed.

This is pretty complicated and the subject of its own later chapter. So for now, we will move on to how the misalignment of backward rotated pelvis and outward tilted legs changes the basic shape of the pelvis.

13HIGHER HEELS HAVE THE OPPOSITE EFFECT ON THE FEMALE BODY

To recap the previous discussion, the effect of elevated heels on males tends to cause a bow-legged stance (technically called genu varum). In females, the opposite effect of knock-knees tends result from high heels (called genu valgum). [SEE FIGURE 13.1 – HAMILL P. 213]

The Factors Causing the Opposite Effect: the Typical Knock-Kneed Position of Modern Females

The reason for the opposite modern male/female structural reactions are as follows. First and foremost, females tend to wear much higher shoe heels than males.

Second, and perhaps as important, females tend to have a wider pelvis but shorter legs than men, both of which physical characteristics together create a greater angle of the thigh from vertical (called the Q angle).

Finally, and this may be the decisive factor, the major hormonal differences, particularly that kick in at puberty, which significantly increase the flexibility of the involved female joints, as anyone who has attended an adult coed yoga class is well aware. Male joints tend to be much stiffer, with less range of motion.

The female's more flexible joints include the hip, knee, ankle, and, most importantly, the main longitudinal arch of the foot[1]. Puberty coincides with time period during which the two sexes diverge most significantly with regard to the above structural differences.

The Underlying Cause is the Same for Females and Males: Modern Shoe Heels

Most important, it must be emphasized that the cause of the abnormal structural changes remains the same for females as males, as you should expect. The elevated shoe heels cause the subtalar and ankle joints to rotate outward, causing the tibia to rotate outward into the tilted out position that we have discussed at length before. This abnormal position results in what is technically called external tibial torsion.

The Major Effects of High Heels on Modern Females

The major effects of elevated shoe heels on females are fairly easy to summarize. The relatively higher heels acting on the very flexible foot and ankle joints – particularly the more flexible main longitudinal arch of the foot -- result in the foot pronating excessively (thereby crushing the big toe, twisting it inward).

The tibia rotates inward with the excessive pronation of the foot, but remains unnaturally outwardly rotated relative to the femur (thigh bone). So the knee cap (patella) is misaligned in the knee joint (called patella subluxation).

The large angle from vertical of the thigh (excessive Q angle) forces the knee inward into a knock-

kneed position, which reinforces the excessive pronation of the foot.

The thigh bone rotates internally on the hip joint, following the excessive pronation of the foot and inward rotation of the tibia.

And, finally, the iliotibial tract (or band) ligament causes the pelvis to rotate forward automatically, due to the aforementioned inward rotation of the tibia caused by the excessive foot pronation. [SEE FIGURE 13.2 – IRELAND P. 282]

Elevated shoe heels thus have a dual action on female joints. First, the female joints are pushed outward, like those of males, and second, then the female joints collapse inward, which modern males typically do no.

The female-only dual action in opposite directions reinforces their hormonally-based flexibility advantage over males. This results from females being forced by shoe heels to use a much fuller range of their natural joint motion and thereby retaining it, compared to males.

A Wide Spectrum of Variation in the Angular Degree of Typical Female Knock-kneedness

In similar manner to males, the result over time is that typically both female knees tend to become permanently bent in into a classic knock-kneed position. As a general rule, this is the structural state of most modern females, although the amount or angle of knock-kneedness varies widely. There is a wide spectrum of variation in the typical amount of female knock-kneedness. For each individual, it depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any specific individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

But for the Major Effects of Elevated Shoe Heels, Men and Women Would Be Much More Alike

All of these major effects are well established, except the last (which you can confirm for yourself with the simple test described earlier in Chapter 8). What has been missing until now is the identity of the single unifying cause for all these significant effects, which is elevated shoe heels.

This description is of the extreme effects which elevated shoe heels can cause. But, like males, most females will lie on a spectrum somewhere between this extreme and a much lessor effect, depending on highly individual factors and luck.

If your think about it, this is all pretty extraordinary. The same basic cause - elevated shoe heels unnaturally tilting out the ankle joint and shin bone - has the opposite effect on women and men, greatly increasing the abnormal structural and functional differences between them. If we were like primitive, barefoot populations, without elevated shoe heels, men and women would be much more alike structurally.

The Difference in Pelvic Rotation Between Modern Male and Modern Female Is Substantial and Unnatural

The stark difference between the typical male pelvis backward rotation and the typical female forward rotation is shown most definitively by the radically different positions of the sacrum and coccyx (located in the middle of the rear of the pelvis), as shown in Figures 13.3A&B.

The sacrum, which joins the two sides of the rear pelvis, is the base of the spine, so its major difference in these figures shows how different the typical pelvic position is in males and females. The wide difference is unnatural and caused by elevated shoe heels, as noted earlier. [**NEW FIGURES 13.3A&B** – GRAY'S ANAT ONLINE]

A Wide Spectrum of Variation Exists in the Degree of Angular Rotation of the Pelvis of Each Individual Male and Female

As was the case with bowed out or in legs, the result over time is that typically male and female pelvises become permanently rotated backward or forward, respectively. As a general rule, this is the unnatural structural state of most modern males and females, although the amount or angle of pelvic rotation varies widely, even occasionally its direction. There is, of course, inherently a wide spectrum of variation in the amount of typical male or female pelvic rotation. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any given individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

These Abnormal Changes to Women Make Them Prone to Both Acute and Chronic Injury

The injury rates for females in athletics is far higher than males in nearly every category of injury. Women have far higher rates of arthritis as well. All due to abnormalities caused by the dual effect of the higher heels of shoes on women, compared to the single effect of lower heels on men.

14UNNATURAL PELVIC SHAPE MAKES CHILDBIRTH VERY DIFFICULT

One general effect of the front end misalignment on the pelvis is pretty simple. With both feet and legs routinely pointed in different directions to the outside, the pelvis in the middle is pulled apart.

The Unnatural Modern Pelvis is Wider and Flatter than the Primitive Natural Pelvis

The result is that the unnatural modern pelvis is widened and flattened. The natural pelvis of primitive barefoot populations is narrower and rounder. [SEE FIGURE 12.1 – FIG. 24.I-2] This natural rounder shape is especially true of the brim through which childbirth occurs. In contrast, modern pelvic brims are noticeably flattened from front to back[1]. Therefore, childbirth is typically much easier for women in primitive barefoot populations.

Obviously, this is a deeply troubling problem with respect to women and childbirth. As usual, the problem is conventionally thought to be caused by nature. Specifically, the incomplete evolution of humans from quadrapeds to their unique bipedalism. Of course that's wrong, again it's the stupid shoe heels.

The main problem in human childbirth is the size and shape of a human baby's head. It is huge, twice the size of our closest animal relative, the chimpanzee. The head on the skeleton of a new born is so large it makes the skeleton look like it must belong to a space alien. [SEE FIGURE 12.2 –]

The Brim of the Deformed Modern Female Pelvis is Too Small For the Huge Human Baby Head

The bone of the female pelvic brim and the baby's relatively huge skull are about the same size (see Figure 12.3). So the fit is far tighter than other primates. But mismatched in shape also, so that the baby must enter the birth canal sideways, and then make a difficult 90 degree turn, all because of the unnaturally flattened brim and pelvis[2].

The head of the fetus has somewhat flexible sutures within the bone of the skull that help the fetus squeeze through the birth canal. However, that inherently difficult birth passage is the most traumatic event to which the fetus's brain is exposed, so the danger to it is great and any damage can have severe aftereffects extending throughout later life.

Although relatively high elevated shoe heels were initially worn by men, by the 19th Century their predominate use was by women. Countless women and children have died tragically and needlessly in childbirth as a result.

And the cost is not just in lives lost in childbirth.

There are a few old studies that indicate that the babies of primitive, barefoot populations develop significantly faster, such as in learning to walk[3]. It seems reasonable to conclude carrying a baby to full term in nine months in an abnormally backward rotated and malformed pelvis is bad. It would lead to

abnormal development in the womb resulting in birth defects and potentially abnormal development after birth as well. The need to fully explore this issue is urgent.

The Malformed and Forwardly Rotated Female Pelvis Pushes Many Important Internal Organs Out of Their Natural Position

The unnatural position of the female pelvis has other likely consequences of a heretofore unknown and adverse nature.

Critical to our understanding of the misalignment problem is that pelvis is the Latin word for basin. That basin is piled high with our internal organs. It would seem likely that tilting that basin backwards would likely shift our intestines and bladder out of their natural positions, slowing down or even temporarily blocking passage of their contents. Heartburn, indigestion, gas, constipation, diarrhea, hemorhoids, and incontinance are likely direct effects of the abnormality.

Other major and minor organs would likely be affected as well, because the multitude of interconnections and interactions are amazingly complicated and often quite delicate. The function of these organs and in the interdependent systems of these organs is likely to be degraded in approximate proportion to the degree of pelvic structural abnormally.

The Unnatural Backward Rotation of the Malformed Male Pelvis Is Also Abnormal, Like the Female Pelvis Forward Rotation

The likely structural and functional consequences of the wider, flatter, and backwardly rotated male pelvis are parallel to those of the female pelvis described above.

A Wide Spectrum of Variation Exists in the Width or Flatness of the Pelvis of Each Individual Male and Female

As was the case with bowed out or in legs and pelvic rotation, over time, typically male and female pelvises become permanently both more wide and flat. As a general rule, this is the unnatural structural state of most modern males and females, although the amount of width or flatness varies considerably. There is inherently a wide spectrum of variation in the amount of typical male or female width or flatness. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

15RACIAL DIFFERENCES CREATED BY SHOE HEELS

As mentioned earlier, previous studies on primitive, barefoot human populations have always attributed differences in anatomical structure or function to racial causes. That is to say, genetic differences that are preordained and unchangeable.

In contrast, I believe that I have provided good evidence that the differences are due to changes wrought inadvertently by elevated shoe heels worn by modern populations. And also, that the changes have been major misalignments resulting in malformations that have reduced structural efficiency and functional performance, as well as having caused disease and injury.

Ironically, all of the early, 19th and early 20th Century studies that I have gone through are based on the deeply prejudiced assumption that the primitive, barefoot races were a lower order of being, at an earlier stage of evolution than those of white Western European heritage. The definitive history of this sorry episode in scientific research is summarized brilliantly in 1981 by Stephen Jay Gould in an award-winning book titled, "**The Mismeasure of Man**".

The Superior Athletic Performance of the "Inferior Races"

Certainly one of the fundamental premises of this old racial prejudice – the functional inferiority of the "primitive" races – is laughable in today's world. What was considered back then the least highly evolved of the primitive races, the Africans, are today clearly the most successful in terms of athletic performance.

From Jamaican sprinters to marathoners from Kenya, their dominance in running today is only occasionally interrupted by outsiders, who have access to all the advantages that modern technology can provide.

In contrast, the principal advantage of the modern Africans is lack of modern technology. It is that their parents and they were usually very poor and physically developed barefoot, without modern shoes. This lack of exposure to modern footwear appears to be especially critical in the early years after birth. It may also be that conception by non-abnormal parents and spending 9 months in a non-abnormal womb could be just as important.

At any rate, transition to modern athletic shoes later in life does not appear to diminish their performance advantage. By their late teen years virtually all elite athletes in Africa have been identified by local and foreign coaches and transitioned to modern athletic shoes, but they still retain their performance edge.

Another irony is the well-meaning Westerners are now providing modern athletic shoes to "help" these unfortunate runners by giving them what they think is better equipment. As this trend continues and strengthens, and as their third world economies continue to improve, their advantage will gradually fade.

Also unfortunate for their future performance, all the good originally-barefoot runners know that their biggest potential source of future income is an endorsement contract from an athletic shoe company. They can't get endorsements by continuing to run barefoot. So they learn early on to covet and use modern athletic footwear as soon and as much as they can.

Today, with most racial barriers gone, the widespread success of athletes with an African heritage cannot escape the notice of even the most casual observer. But, oddly, it is almost never discussed openly.

Racial Differences Are Too Sensitive to Discuss or Analyze

The situation is so odd that a book was published in 2000 with the title, "**Taboo: Why Black Athletes Dominate Sports and Why We're Afraid to Talk About It**", by Jon Entrine.

I went to that book in hopes that it would be a good source to find out more about the physical differences between black athletes and others. I was frankly amazed to find almost nothing very specific there about any such physical differences.

So, apparently, even in a book with such an explicitly provocative title, anatomical features and functional differences are still too sensitive to discuss openly. And even for what appeared otherwise to be a courageous author unafraid to tackle difficult issues.

Despite this conspicuous warning to stay away from more explicit racial differences, I am going to proceed. Not because I am foolhardy (or worse), but because essentially my evidence-based analysis is this: all significant racial differences are based on changes caused by footwear, not preordained by genes.

All Races Are Basically as Interchangeable as Our Footwear

That is an exceptionally positive position. For starters, it means that if you have basis for any prejudice at all, it should be prejudice directed against your footwear.

It is also positive because we can use that knowledge to develop effective means for all of us to be far healthier and far better athletes as well. What is achievable by those who have not been deformed by footwear can potentially also be achieved by the rest of us who have been so deformed if we understand the true causes in order to develop real solutions.

Our current deformities have severely limited our own performance in every aspect of life. They have also severely limited our view of the limits of human performance. Our current imagination is trapped by the limits imposed by our existing deformed state.

The limits of human performance are much higher than we can currently imagine now

With this new understanding of our current state of deformity, the bell curve of human performance can be shifted dramatically upward. To put it more tangibly, we can all "be more like Mike" (and Michael Jordan could himself have flown even higher and been injured less).

What we now regard as highly exceptional is much closer to the natural norm of human potential. We only fail to realize this because of our current deformities anchor us within unnatural limits.

To give you another example of what I am trying to say, look at this picture of the limbo king of New York City performing in the 1960's. [SEE FIGURE 14.1 – NYT PIC] This picture demonstrates an almost unbelievable performance extreme. But all of us have the genetic potential to come much closer to it than our current limited imaginations allow.

Before everyone gets too comfortable with this vision, we do need to explain away an anomaly. The superior athletic performance of African Americans who use modern athletic shoes must be carefully evaluated.

Certainly significant is a factor mentioned above, that most African American athletes are born and develop in families in poverty or near it. So their families' use of modern footwear, especially at the most important early ages may be relatively far less common. But we still have to account for superstar athletes like Grant Hill, Kobe Bryant, and Steph Curry, all of whom must have had easy access to the latest kicks, given their highly privileged family backgrounds.

Many Africans Have a Minor Genetic Trait That Reduces the Adverse Effect of Elevated Shoe Heels

Many Africans seem to have retained a genetic trait that most of the rest of us have lost in the migrations of genus homo out of Africa in the last hundred thousand years. The seemingly minor trait is almost impossible not to overlook and would seem to be completely trivial. Except that it appears to interact directly with elevated shoe heels.

What I am referring to is the main (longitudinal) arch of the foot, which in many Africans tends to be lower than in non-Africans. Unfortunately, reliable information on this trait is very limited, although fairly consistent. There is a great deal of confusion on this subject relative to definitions and function in the earlier research, but recent work seems clearer, although better work in greater depth still needs to be done[1].

The Shoe Heels Have Much Less Effect on the Lower Arch of the African Foot

There is no research whatsoever on the effect of elevated shoe heels on the lower arch of the African foot, so I have to resort to my best guess, which I would prefer to characterize as careful speculation based on logical analysis of the what limited information is available.

So, what I believe happens as a result of the lower arch of the African foot is that there is less abnormal foot supination caused by elevated shoe heels. The reduced abnormal supination is probably caused by a minor difference is the structure of the subtalar joint, the minor joint difference being associated with the lower arch structure.

None of this explanation has ever been researched before by anyone. At this early stage of analysis, it is only my working hypothesis, but it is the most logical one in existence that explains the few available facts.

Excessive Pronation Is Limited By the Low Arch Bottoming Out Into a More Stable Position

In short, with lower main arches, shoe heels should have less abnormal effect. Whatever abnormal foot supination is produced by shoe heels is absorbed by a counter-balancing pronation of the African foot that is made more flexible by the lower arch.

I think the less severe abnormal supination in the lower arch African foot still produces lower leg instability and still causes excessive and abnormal pronation as a result of the instability. But the lower arch of the African foot should be inherently more stable because, being lower, it cannot collapse as far in excessive pronation.

In other words, it would naturally bottom out in a reasonable stable position. Low arches have been shown to correlate with fewer injuries[2].

The African Lower Arch Results in the Lower Leg Being Tilted Inward Into a Knock-Kneed Position

However exactly this shoe heel/ankle joint mechanism happens, the result of shoe heels on African athletes is relatively easy to observe empirically. Generally, instead of the lower leg being tilted out into a bow-legged position by a supinated foot, the lower leg tilts inward into a moderate knock-kneed position by a pronated foot.

You can easily observe this knock-kneed effect in any professional NBA or NCAA collegiate basketball game broadcast on television. Using the slow motion feature of your video recorder makes it impossible to miss.

It is also easy to see that this moderate knock-kneed effect is a very useful adaptation in terms of superior athletic performance. The most obvious example is remarkable jumping ability, sufficient to almost effortlessly dunk the ball. This ability reaches almost ridiculous extremes, such as when 5 foot 7 inch Spud Webb won the NBA slam dunk contest.

Clearly, without the primary abnormality of bowed out legs, the rest of the human body naturally develops much more normally. So, the whole chain of major problems discussed in preceding chapters and caused by shoe heels is broken.

Lower Arches and Moderate Knock-Knees Are Not Unique to African Athletes

It is worthy of note that most non-African athletes with exceptional physical gifts also tend to have lower than normal arches and moderate knock-knees. The available research on this point is also very limited, but some important examples are worth discussing.

Refer back to earlier Figure 4.3, which shows a non-African patient, but with knock-knees having the highly developed vastus lateralis thigh muscle characteristic of African athletes. Figure 4.4 shows the same patient after thigh bone surgery that resulted in a bow-legged stance, and with far less vastus lateralis muscular development that is more typical of modern non-African populations, particularly men.

Clearly, then, non-African legs can naturally develop in a knock-kneed position to be just like African legs, and they can also be modified to develop into a bow-legged position characteristic of non-Africans. It' s all in how they individually react to specific elevated shoe heels they use.

And again referring to Figure 4.2, the non-African fetus definitely shows the hyper development of the vastus lateralis muscle common to Africans. Lack of exposure to shoes is the difference.

Many Non-Africans Have the Same Kind of Superior Athletic Performance

To grab just one example out of a great many, Duke University won the Men's NCAA Basketball Championship in 2015 with three freshman superstars, all of some African descent. However, the kid on that championship team with the greatest vertical leaping ability was another freshman star who was a non-African (and who also won the 2014 McDonald's All American Slam Dunk Contest). [Video Link]

To sum up again my firm, evidence-based conclusion: all significant racial differences are based on changes caused by footwear, not preordained by genes.

It Is Not Possible to Assert That Lower Arches Correlate With Intelligence

I am taking the position that many of those of Africans descent appear to have a minor genetic trait in the form of a lower foot arch, which would probably be totally innocuous except for its now apparent hidden interaction with elevated shoe heel. Since I am alleging this minor genetic difference, I want to be emphatic that there is to my knowledge no evidence whatsoever that this difference somehow correlates to lower intelligence. There is no known basis for such blatant and misguided racial prejudice.

As a matter of fact, the only relevant information of which I am aware strongly suggests the exact opposite. It has been reported that Albert Einstein had low arched feet. He was well known to get around Princeton in sneakers. However, as far as in known, he had superior physical ability in only one area, playing the violin. So Gary Larson's cartoon has no basis in fact, only in humor. [SEE LARSON BASKETBALL CARTOON]

In the Future Specific Genetic Markers Should Be Far More Useful Than Obsolete and Inaccurate Concepts of Race

I have been forced in the discussion above to make use of the term, “race”, because all of the existing studies relative to human body structure that are relevant to the research on which this book is focused are catagorized on the basis of existing racial concepts, some extremely prejudiced, especially those dating back to the 19th and early 20th Centuries.

Those obsolete and inaccurate concepts of race have often been inappropriately linked to being inherently primitive and barefoot. I am interested only in the barefoot part, which certainly is not inherent. I am only trying to learn whatever is available about the natural, normal state of the human body, and not in race generally or in any of the allegedly racial characteristics like skin color.

In point of fact, I am really only interested in genetic markers for human foot structure, and more specifically, for the main longitudinal arch and/or the subtalar joint. Unfortunately, no such foot genetic markers currently exist, at least to my knowledge (which at this point is very limited in the field of genetics anyway).

16SHOE HEELS CAUSE THE CROSSOVER OF FEET

At this point, we will focus on the legs when running. We will take the simplest case first, which is the symmetrical case. Then we go on to see how symmetry transitions into asymmetry.

Both Tilted-Out Legs Are Therefore Tilted-In At the Hip and Anchored There, Causing Crossover of Feet

Some of the earliest work on asymmetry in running that I've seen was done by Steven Subotnick and his last book is the definitive podiatric textbook, **Sports Medicine of the Lower Extremity**. In it, he includes an illustration from 1979 that shows the distance between footprints in lateral sports(A), walking (B), running (C), and jogging (D)[1]. [SEE FIGURE 15.1 – p.189, Fig. 12-2]

What you see in jogging (D) is a crossover of footprints, wherein each footstep crosses over in front and inside of the preceding footstep. Also shown in jogging (D) is the functional varus typically observed ("functional" meaning not caused by structural bone changes).

The cause of the functional varus was unknown back then. But with our new understanding of the role of shoe heels, we can correctly interpret the observed crossover as a direct function of the inward collapse noted above.

The simplest way to see this is as follows. Both legs are anchored to the pelvis at the hip, so if they are tilted-out relative to your foot, they are also automatically tilted-in relative to your hip. Your whole upper body mass keeps your hip from moving sideways very much, so what happens automatically is your feet move toward each other and then past each other. They have to crossover automatically if the tilting out angle caused by shoe heels is sufficient to make it so. [SEE NEW FIGURE 15.2 - FE MAKE]

If both your legs were simultaneously tilted out, your feet would have to cross for you to remain standing. When you run, only one leg is tilted at time, but each tilted leg would push your relatively heavy upper body to the opposite side, which is difficult and highly inefficient. So your body compensates in the simplest and easist way possible, by moving your legs in with each step rather than moving your whole body out, from side to side.

The unnatural crossover problem is inherently unstable. Most obviously, it enables one easily to trip over one's own feet. Just as obviously, lateral stability is significantly reduced because each foot is abnormally positioned far from the side for which it needed to stabilize.

This is a much more dangerous problem than you might think. The crossover of a jogger's feet greatly increases the likelihood of a lateral ankle sprain, which can cause lasting stability problems.

17SHOE HEELS MAKE RUNNING ASYMMETRICAL

So far we have been considering only the simplest case, the symmetrical one. That is, wherein both right and left sides of the human body react exactly in parallel to the abnormal effects that are caused by elevated shoe heels, as discussed in preceding chapters.

Both sides of the human body certainly are symmetrical, with each side having essentially the same set of parts. That is obviously true for your arms and legs. The major exception is of course the location of your single heart locate more over on the left side and some other internal organs located in asymmetrical positions in your trunk.

Unfortunately, we have a big problem. It is directly related to our unique evolution from quadrupedal to bipedal locomotion. With only two supporting lower limbs, balance between both limbs becomes a critical structural issue.

The Misaligned Front End Caused by Shoe Heels Collapses Into Asymmetry

Simply put, elevated shoe heels destroy this critical balance. The splayed-out to the sides position of the ankles and legs, as well as the backward tilted pelvis, creates an inherently unbalanced alignment of body parts unfit for running naturally in a forward direction. This is the unnaturally misaligned front end discussed in Chapter 11.

The fundamental problem is that the only way to resolve the splayed-out misalignment is to collapse inwardly, so the unstably tilted out legs point more ahead instead of to the sides.

The trouble is this correction process is totally ad hoc. It usually produces serious asymmetries between the right and left legs. This asymmetry problem between legs is compounded by the abnormally tilted position of the pelvis connecting them.

We will discuss the interaction between the legs and the pelvis in the next chapter. For now, we will focus on the well understood and extensive asymmetry that exists between the right and left legs of runners equipped with modern footwear having elevated heels.

Bilateral Asymmetry Between Right and Left Feet and Legs Is Common

Both of the earliest modern running studies by Subotnick and by Cavanagh cited already discuss individual cases of asymmetry of a substantial nature, even among elite athletes. For example, Cavanagh discussed an elite 10,000 meter runner who, running at race pace, sustained a maximum force of 4 G's on his right leg and 2.5 G's on his left – an amazing 60 percent more on the right.

Most other studies that have focused on asymmetry have been limited to standing or walking, but there is general agreement in a multitude of studies that asymmetry in human locomotion is pervasive.

The Primary Function of the Right Leg is Propulsion, the Left Leg is Support

The best information I have been able to cull is from two different studies by Sadeghi et al[1]. The

principal findings were that the right leg is most typically involved mainly in propulsion involving hip power in particular during the push-off phase of stance and is secondarily involved in support. The left leg is involved mostly in the function of support.

From the later Sadeghi review study, the consensus seems to be that, for right handers, the right leg is typically the dominant leg and the shorter one, while the left leg is non-dominant and longer. For left handers, the opposite.

The Distortion of the Running Stride Illustrates the Underlying Distortion of the Runner's Body

The result of this most typical human physical structure on the running is illustrated in Figure 16.1, which is from Muybridge's 19th Century pioneering motion studies. To it was added a vertical line through the small of the runner's back, to indicate his approximate center of gravity.

The photograph on the right shows the short right leg in the mid-support phase of running. What is striking is the extreme crossover of the right leg, well inside the center of gravity, caused by the excessive outward tilt of the lower right leg, about 11 degrees. Also important is the level position of the pelvis.

In contrast, the photograph on the left shows the long left leg in the same mid-support phase of running. No crossover is shown, the foot being directly under the center of gravity, because there is less outward tilt of the lower left leg, only about 9 degrees. But note how the pelvis is tilted down from the high left side, causing the runner's backbone to bow out to the right side.

The Dominant Right Leg Stays in the Same Position Relative to the Pelvis: Splayed-Out to the Right Side

To this general picture we can add from a study by Stefanyshyn and Engsberg[2] that the right foot tends to rotate to the outside more, while the left foot rotates to the inside more. I think this provides a hint to how the abnormal and unstable splayed-out position (caused by elevated shoe heels) collapses inward.

Using logic and the facts as we know them, here is what I think happens when running. The dominant right leg typically wins the battle between the two legs pointed in different directions in the horizontal plane. It remains splayed out to the right relative to the pelvis, without rotating inward at the hip in the horizontal plane. The right leg also remains vertically tilted out, about 11 degrees in the frontal plane.

The Right Side of the Pelvis Is Rotated Abnormally Forward in the Horizontal Plane

At the same time, in the horizontal plane, the pelvis rotates forward on the right side, so the right propulsion leg is pointed forward generally in the direction of travel, despite remaining abnormally splayed outwardly. So the right leg completes its stance phase with the right side of the pelvis rotated abnormally forward in the horizontal plane. [SEE NEW FIGURE 16.2 – FE MAKE]

Now we get to the critical part. With the right side of the pelvis rotated abnormally forward in the horizontal plane, the left foot must abnormally rotate inwardly toward the pelvis in order to be pointed

forward in the same direction of travel as the right foot and leg.

The Left Leg Is Twisted Between the Left Foot Rotated Inward and the Left Hip Rotated Outward

But the left leg is attached by the hip to the pelvis abnormally rotated outwardly in the horizontal plane. So when the left foot lands and is fixed onto the ground, the ligaments and muscles of the left hip rotate the left leg to the outside to its natural load-bearing position pointed forward relative to the left hip.

As a result, the left leg rotates to the outside, forcing the left foot to supinate at the maximally loaded mid-stance point of the running stride. This is highly abnormal. Normally the left foot would be pronating to absorb the body weight load at the maximally loaded mid-stance point of the running stride.

This is very bad news! At the same critical time in the support phase of the running stride, the left foot is being abnormally supinated, becoming rigid and higher, while the right foot is pronating relatively normally, becoming flexible and lower.

The result is a significant functional leg length discrepancy between right and left legs caused by elevated shoe heels.

The Battle in the Left Foot Between Normal Pronation and Abnormal Supination

With very little formal research to support this, I will nonetheless express the opinion that I believe elite runners tend to at least partially compensate for this abnormal supination by pronating relatively excessively with their left foot compared to their right, so their left foot toes-out more than the right foot.

Conversely, less elite runners and joggers, particularly male, toe-in more on their left foot. That signifies the relative supination of the left foot compared to the pronation of the right, which creates greater asymmetry in the form of a relative leg length discrepancy.

The Typical Left Leg is Shockingly Deformed, Functionally and/or Structurally

Based on this analysis, there is something else to see in the left side of Figure 16.1. It is shocking. The left leg is actually tilted out 20 degrees, not 9 degrees, if you measure it relative to the pelvis, which is tilted down on the right by about 11 degrees (measuring from the best available anatomical landmark, the well-defined butt crack).

What this effectively means is the both legs are tucked up under the runner, with even much more crossover on the left side than the right, instead of the less crossover that was superficially apparent. This structural distortion is so great it makes the runner's legs function sort of like partially retracted landing gear.

The Left Leg is the Farthest Out of Natural Position and Reduces Gluteus Maximus Action

So the left leg is even more adversely affected than the right leg. That seems to explain why it is

effectively much less effective providing propulsion and is relegated to support only.

The reason is the gluteus maximus becomes ineffective due to its attachment points on the pelvic crest being moved in about the same direction of pull as the gluts by the iliotibial band without muscle power, as explained earlier in chapter 9.

The principal motive force in the propulsive phase comes at the hip, as provided by the gluteus maximus. With the abnormally rotated position of the pelvis, only the right hip and gluteus maximus work.

Over Time These Functional Abnormalities Gradually Become Permanent Structural Abnormalities

One more point. Look again at the left side of Figure 16.1. You can see abnormally high left side of the pelvis. At least at the beginning, this abnormality is strictly a functional problem in mismatched leg length.

But over time, it will unavoidably lead to changes in leg length based on bone structure, again by Woolf's Law. The functional differential overloading problems of the two legs are gradually frozen permanently into structural problems, just as they are with the knee.

Consider again the example mentioned earlier of an elite 10,000 meter runner who running at race pace sustained a maximum force of an amazing 60 percent more on the right leg than the left leg. Extreme force asymmetries like this are bound to create substantial structural effects over time.

Moreover, this example is of an elite runner performing at very high level of performance and therefore probably with much better than average structural right/left symmetry than the non-elite population.

Right Handedness Correlates with Dominant Right Leg, Like Figure 16.1?

A final note. The dominant right leg would seem clearly to be related directly to right handedness. If so, then Figure 16.1 may illustrate the most general relationship between right and left legs, given the substantial predominance of right handedness.

That would still leave the question of left handedness and whether the relationship between legs simply switches positions or is less predominately either way. This is an area that needs much more basic research, so I have not been able to pursue it at this time.

The Situation Is Likely Even More Complicated Because of Very Common Random Injuries Like Ankle Sprains

My guess is that there are likely a number of functional and structural variations, at least as subsets of the basic sets, like that shown in Figure 16.1. But luck and accidents are likely to play a big role in what happens to each individual, given the extremely unstable and unnatural midstance running positions shown in Fig. 16.1.

For one thing, both legs are tilted-in so much, ankle sprains are highly likely, especially when modern

shoes with elevated heels are worn. As noted earlier, such heels supinate the foot, increasing the likelihood of lateral ankle sprains, which therefore happen all the time.

It is becoming increasingly well documented that a large number of such seemingly simple ankle injuries do not heal properly and become chronic injuries. In such cases, it is highly likely that such injuries lead directly to asymmetrical functional and structural problems. And probably in a relatively random way in terms of specific effects on the human body.

A Wide Spectrum of Variation Exists in the Amount of Crossover of Each Individual

As was the case with bowed out or in legs and pelvic rotation, width or flatness, over time, typically male and female permanently develop a significant degree of crossover. As a general rule, this is the unnatural structural state of most modern males and females, although the amount of crossover varies considerably. There is inherently a wide spectrum of variation in the amount of typical male or female crossover. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

18SHOE HEELS HAVE MADE RUNNING BAREFOOT POTENTIALLY DANGEROUS

Returning yet again to Figure 16.1, you probably missed something that is crucial, but which is not obvious in Figure 16.1, although it is obvious in other Muybridge frames showing side views of the runner. The crucial thing is, the runner is barefoot.

What you are seeing in Figure 16.1, then, is the effect of removing the elevated heels typical of the street shoes of that day. The new "normal" for the runner shown in Figure 16.1 – whose body has almost certainly been significantly deformed by habitual use of elevated shoe heels - is "abnormal".

It therefore requires continued use of elevated shoe heels to retain its "normal" state. Trying to return to a natural state by removing the offending shoes does not work if your body has been significantly deformed, as most have.

Since running barefoot has become the new abnormal normal, removing shoes makes the abnormality even worse. Essentially, the body collapses further. I believe that is why the asymmetry deformity illustrated in Figure 16.1 is so extreme.

This conclusion is supported by a recent study by Hoerzer et al that showed that the gait asymmetry of young adult runners is reduced when running in shoes compared to doing so barefoot[1].

So the intuitive logic of returning to natural barefoot running has been made perversely illogical by shoe heels and replaced by a counter-intuitive unnatural reality. As a consequence, simply reverting to natural barefoot running is dangerous unless elevated shoe heels have not already significantly deformed your body.

19SHOE HEELS TILT THE PELVIS ASYMMETRICALLY

As you may recall from Chapter 8, when elevated shoe heels tilt out the ankle and tibia, that automatically tilts the pelvis backwards because of the iliotibial tract connection between the tibia and the pelvis.

So when the right and left legs end up in an asymmetrical position relative to each other, as we have shown, the pelvis also becomes asymmetrically tilted. This is really bad.

I can't emphasize this enough. Asymmetrically tilting your pelvis is really, really bad!

Shoe Heels Cause Your Pelvis to Tilt Abnormally in All Three Dimensions

Everything above your pelvis is supported by it. Far more than just forming a basin that directly holds your lower internal organs, the pelvis also directly supports your backbone or spine upon which the entire structure of all of your upper body depends.

To grasp the extent of pelvic asymmetry problem, look at Figure 15.1. It shows the six directions in which the pelvis can move in all three dimensions. [SEE FIGURE 15.1 – HAMILL#2 192] The pelvis can tilt forward and backward in the sagittal plane, either side can move up or down in the frontal plane, and the pelvis can rotate to the right or left in the horizontal plane.

What is really, really bad is what happens when your legs more or less collapse inwardly and asymmetrically (because of the inherently unstable splayed-out position of Chapter 11 and the running asymmetry of Chapter 17).

Your pelvis is automatically moved into an asymmetrical position where one pelvis side is tilted forward, laterally tilted down, and rotated inward relative to the other pelvis side. Over time, the pelvis is thereby molded into an asymmetrical shape, of which Figure 18.1 is an example.

The Asymmetrical Pelvis Becomes Deformed and Forces the Spine Into Unnatural Positions

This abnormal, tilted position becomes the default neutral foundation of support for the spine, dictating inexorably that the spine will be tilted or twisted in an unnatural direction. That basic structural abnormality will fundamentally affect the upper body in an unnatural way. More about this in later chapters.

Also, over time this asymmetrically positioned pelvis is distorted structurally by the unnatural forces acting upon it by the asymmetrically collapsed position of the legs, like those shown in Figure 16.1. The result is a human pelvis that is not just structurally flattened, but also asymmetrically deformed from one side to the other side.

Childbirth and Development Within the Womb Are Both Adversely Affected

All of the serious childbirth (and organ position) problems, with directly related functional problems, previously mentioned relative to the pelvis being tilted backwards for males or forwards for females

become even worse with additional asymmetry problems added to them.

As mentioned previously, there are a few old studies that indicate that the babies of primitive, barefoot populations develop significantly faster, such as in learning to walk. It seems reasonable to conclude carrying a baby to full term in nine months in an abnormally forward tilted and mis-shaped pelvis is bad. It would lead to abnormal development in the womb

Studies indicate that about two-thirds of fetuses are carried in the same asymmetrical position in the womb. That apparently abnormal position is with the head down and right ear facing the mother's front. In other words, the fetus is rotated about 90 degrees to the left side, probably due to the mother's pelvic asymmetry, as shown in Figure 18.2.

The unnatural position would likely affect the development of the fetus adversely during its term in the womb and potentially after birth as well. Again, the need to fully explore this important issue is urgent.

Since Pelvic Symmetry Is Important, How Do You Tell If Your Pelvis Is Rotated Asymmetrically?

Leaving aside resorting to a clinical visit for analysis by an Orthopedist, there are some telltale signs you can observe yourself to gauge your own personal level of pelvic asymmetry.

First, and probably the easiest, if you have six-pack abs that are symmetrical, your pelvis is probably aligned properly. Interestingly, classic ancient sculpture up to the Renaissance have symmetrical abs, like Leonardo's David. Many modern six-pack abs have obvious asymmetry indicating underlying pelvic asymmetry, even with substantial muscular development, like that shown in Figure 18.3. Of course, if your six-pack abs are covered by a spare tire, there's no easy way to know.

Telltale Male Equipment and Hidden Female Equipment

Second, if you are male, pelvic asymmetry is indicated by one testicle hanging lower than the other, such as the extraordinarily exaggerated testicular mismatch displayed by the motion photography pioneer, Eadweard Muybridge, in Figure 18.4.

This mismatch may be accompanied by a hanging or twisting of the penis to the right or left side. Apparently custom tailors adjust for the common mismatch of male equipment by politely inquiring whether you “dress right” or “dress left”. Presumably, no one had to ask Eadweard.

If you are female, obviously no such test is available. However, with considerable difficulty, you can get a somewhat equivalent assessment. I noticed this mismatch by chance, when my girl friend was performing yoga without getting dressed and was in the plow position. As I happened by, I observed her labia were shifted noticeably, so one side was distinctly lower than the other. However, since the plow is a fairly dangerous position, I would not suggest that you try self evaluation to avoid embarrassment. Doing so would be alot more difficult than whatever you may have learned to do from “The Vagina Monologues”.

The Simple and Easy Pelvic Symmetry Test (Although With Uncertain Accuracy)

Finally, there is an easier way for anyone of either sex to assess their pelvic asymmetry, although I am less certain of its accuracy. Just lay on your back flat on the floor with your legs spread apart comfortably, totally relaxed. Bend your head up slightly, enough to see what position your feet are in. If your feet are bent out at different angles, one rotated outwardly more than the other, your pelvis is probably asymmetrically positioned.

Similarly, when you are walking or running, if one foot angles in or out (toes-in or toes-out) more than the other, that also suggests pelvic asymmetry. But be careful to watch where you're going when you check.

A Wide Spectrum of Variation Exists in the Asymmetry of Each Individual

As was the case with previous abnormalities, over time each individual typically becomes permanently both more asymmetrical. This is particularly true at least while the individual remaina physically active; with much less physical activity typical of aging, the asymmetry reduces somewhat beacause there is no longer a force producing it.

As a general rule, this asymmetry is the unnatural structural state of most modern males and females, although the amount of asymmetry varies considerably. There is inherently a wide spectrum of variation in the amount of typical asymmetry. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

20SHOE HEELS CAUSE WIDESPREAD LOW BACK PAIN

Low back pain occurs in the lumbar spine, shown in Figure 19.1. It is said to affect 80 percent of U.S. citizens at some time in their lives, having reached something like epidemic proportions.

The lumbar spine includes five vertebrae and a sacrum (essentially fused vertebrae), and connects at its lowermost part, the sacrum, to two rear sides (ilium) of the pelvis by the infamous sacroiliac joint.

The sacroiliac joint is considered the weak link of the entire vertebral column or spine

Like all of the other serious diseases discussed in prior chapters, the cause of low back pain has never been identified. Like the previous problems, it is generally thought to be a product of incomplete evolution to the unique bipedal locomotion of humans.

As we have seen earlier, this view is entirely incorrect. Low back pain is definitely caused by the unnatural direct effects of elevated shoe heels. In its natural, undeformed state the lumbar spine is strong and stable.

As noted in previous chapters, particularly 8 and 12-13, shoe heels unnaturally tilt the pelvis, typically backwards in males and typically forwards in females. Inherently, then, the joint between the ilium of the pelvis and the sacrum of the lumbar spine - the sacroiliac joint - is abnormally affected by the abnormal position of the ilium.

Like the other joints discussed previously, the abnormal position of opposing joint surfaces caused by shoe heels adversely alters the structure and function of the sacroiliac joint.

The Structure and Function of the Sacroiliac Joint Are Unnaturally Altered in the Male Flat-Back

Critically, the range of motion between the pelvis and the lumbar spine is significantly reduced[1], which I believe corresponds to the backwardly tilted pelvis and flat-back condition typical of males. This results in what can be termed a static spine, as shown in Figure 19.2B.

I think the forward rotation of the pelvis in the horizontal plane as discussed in chapter 16 compounds the problem, helping to lock the flat-back into a relatively immobile position.

The highly abnormal flat back is characterized by almost no axial rotation, as shown in Figure 19.3. The unnatural absence of axial rotation extends all the way through through the lumbar spine and even includes the lowest three vertebrae of the thoracic spine of the chest area.

The abnormal, static position of the flat-back is obvious to the naked eye, if the lumber spine is naked and thus open for observation. You can confirm this obvious low back abnormally in practically any episode of "**Naked and Afraid**" on the **Discovery Channel**, such as the example shown in Figure 19.4. [SEE STILL PICTURE]

This abnormal absence of axial rotation contrasts dramatically the rest of the thoracic spine above the three bottom thoracic vertebrae. This upper thoracic area has symmetrical, approximately equal ranges

of motion for all three types of spinal motion: axial rotation, lateral bending, and flexion and extension.

The Female Lower Back is Typically More Convexly Curved, Called Lumbar Lordosis

In contrast, the dynamic spine, as shown in Figure 19.2A, corresponds to the forward tilted pelvis and convexly rounded lumbar spine most typical of females[2], as shown in Figure 19.5, with a highly mobile sacroiliac joint. The convexly rounded lumbar spine is also typical of primitive, barefoot populations.

Unfortunately, the joint is abnormally mobile, more than would be naturally the case without shoe heels. So abnormal hyper-mobility may be the main problem for most women, for whom low back problems are frequent and often severe.

The greater convex curvature typical of women compared to men noted just above[2] is called lumbar lordosis. Pregnancy can increase the lumbar lordosis significantly, as shown in Figure 19.6.

The Vital Connection Between Sacrum and the Lumbar Spine Is Tilted Into Instability

This relatively extreme pelvic forward tilting of the sacrum results in abnormal sliding motion between the upper surface of the sacrum (S_1) and the lowest lumbar vertebrae (L_5), causing inflammation, forward displacement, or fracture, as shown in Figure 19.7.

Weakened Abdominal, Gluteus Maximus, and Hamstring Muscles Create an Unstable Spine

As discussed in previous chapters, the abdominal, gluteus maximus and hamstring muscles are significantly weakened by the automatic action of the shoe heels tilting out the lower leg, which forces the pelvic backwards due to the iliotibial tract or band.

This non-muscular mechanism is contrary to maintaining the strength of the abdominal, gluteus maximus and hamstring muscles, which are absolutely vital to holding the pelvis in its natural upright position of support for the entire vertebral column of the spine, as shown in Figure 19.8A.

In their abnormally undeveloped state, these three essential muscled groups are weak and thus easily fatigued. Without their necessary firm and continuous support, the pelvis automatically rotates forward into an unnaturally unstable position.

In this abnormal position, the trunk of the body slouches into a position wherein all the spinal curves become exaggerated, as shown in Figure 19.8B. This happens particularly noticeably in a long race like a marathon.

It is important to note that the same position of the abnormally exaggerated upper trunk spinal curvature is created even in the more typically male flat-back position. That is because its principal cause is weak abdominal, gluteus maximus, and hamstring muscles created by the flat-back position, as previously discussed.

21SEXUAL PERFORMANCE, SATISFACTION AND FERTILITY

Before we depart from the lumbar region, we should consider at least briefly the effect on sex of the structural and functional changes caused by elevated shoe heels.

First of all, there is a basic alignment issue. As discussed previously, typically the male pelvis is abnormally rotated backward and the female pelvis is rotated forward.

The extent of this counter-rotation is indicated in Figure 20-1, which shows an upper view of a female pelvis and a male pelvis. The main difference you can see is that the male sacrum and coccyx are rotated far down into the brim or opening of the pelvis.

Comparing its position to that of the female sacrum and coccyx shows clearly the substantial difference in the basic pelvic positions between the male and female.

This abnormal rotation in opposite directions would dictate that the pubic areas at the front of the pelvis would be rotated out of their most natural position of directly opposing each other in the classic, face-to-face missionary position.

Primitive Barefoot Populations Are Not Limited to the Missionary Position

The term “missionary position” is itself an uncomplimentary commentary from those in primitive barefoot populations about a notable lack of variation in sexual positions exhibited by those of supposedly more advanced civilizations. Of course, the missionary view may have been that sex was for procreation only, not enjoyment.

Nonetheless, the far greater variety shown for example in the Kama Sutra may well indicate that those of more primitive, non-Western cultures were more physically able to perform a variety of sexual positions. Specifically, that they had the natural strength and dexterity required to comfortably and safely experience more physically demanding approaches.

On that point, the rectus abdominals and gluteus maximus muscles are the opposing muscle groups that most control the pelvis. They are especially involved in performing the basic pelvic in-and-out motion fundamental to the sex act. But as you recall, they have been weakened by automatic mechanism of the iliotibial tract caused by shoe heels.

The Position of the Female Clitoris May Determine Whether Orgasm Occurs In Intercourse

Marie Bonaparte developed and published in 1924 an elaborate theory that the physical distance between the clitoris and vagina determined whether orgasm was possible for a particular woman during intercourse. She found that the distance needed to be less than an inch (or 2.5 centimeters).

While there is apparently some ongoing studies related to confirming and/or expanding these findings, I mention Mrs. Bonaparte only to emphasize the point that the structure and function of our sexual parts

may well be themselves altered by the larger structural and functional changes we have already discussed that have been caused by shoe heels. For example, Marie Bonaparte's critical inch might be affected by shoe heels.

As you might guess, there is however no research available now on sex and shoe heels, other than stiletto heels seem to encourage it, at least in pornography. For now I can only suggest the book from which I obtained the above information, "**Bonk: The Curious Coupling of Science and Sex**" by author Mary Roach. The book is quite informative, as well as very funny.

Mary Roach is also the author of the book, "**Stiff**", so she is also a convenient segue to my next topic, erectile dysfunction (although her book is actually on the curious lives of human cadavers, which she remarkably also manages to make both informative and funny).

Erectile Dysfunction Caused By Elevated Shoe Heels?

Erectile dysfunction is known to be adversely affected by cardiac dysfunction and I will make the case that shoe heels clearly play a big part in creating unnatural cardiac problems in a later chapter.

There is another issue to discuss here, which is impingement of organs on nerves. The spine consists of a column of vertebrae surrounding the spinal cord. The last left and right nerve branches off of the spinal cord exit from small openings between the S_4 and S_3 vertebrae of the sacrum and they control sexual function.

It seems likely, but unproven at this stage of research, that unnatural pressure on at least one left or right nerve branch is caused by at least one organ such as the rectum, bowel, or bladder shifted out of its natural position and pressing on the bone of the sacrum. A partial hernia could be involved.

This abnormal organ shift is likely caused by the shoe-heel-induced backward and asymmetric rotation of the pelvis. And the unnatural pressure would be the cause of erectile dysfunction.

Shoes and Feet Can Have a Direct Role in a Sex Act?

I for one have never had erotic feelings toward feet. Actually, I think feet are pretty odd looking, if not ugly. Nevertheless, feet and how they can be used, as well as footwear, are extremely erotic for some individuals and in some cultures.

Everything you ever imagined that you wanted to know about such matters, as well as some things you might have preferred never to have known, are described in detail in "**The Sex Life of the Foot and Shoe**" by William A. Rossi. Prepare to be shocked and/or amazed if you get a copy.

Actually, it is a fairly scholarly work, since Rossi is in fact one of the world's leading authorities on footwear and was the longtime editor, now retired, of **Footwear News,** the leading industry publication.

The Abnormal Position of the Pelvis Adversely Affects Delicate Organs Critical to Fertility

The unnatural position of the pelvis, as noted earlier in Chapter 12, causes a particular problems since it

is a basin is piled high with our internal organs. It would seem likely that tilting that basin backwards or forwards and asymmetrically would likely shift our intestines, and bladder out of their natural positions, slowing down or even temporarily blocking passage of their contents.

Other major and minor organs would likely be affected as well, because the multitude of interconnections and interactions are amazingly complicated and often quite delicate. Among the most delicate of these would be the male and female internal sexual organs critical for conception.

22THE TWISTED THORACIC SPINE AND PRESSURED HEART

The structure and function of the thoracic spine and chest are utterly dependent on the position of the pelvis and the strength of the abdominal, glutes, and hamstring muscles that stabilize it.

As we have already seen, shoe heels have forced the pelvis into an abnormal, less stable position and have weakened those stabilizing muscles. And the human body is primarily deformed in its maximally loaded condition, the midstance position during running.

The Thoracic Spine Bows Out to the Right Side, Favoring the Evolution of Right-Handed Runners

As shown in Figure 21.1, which is similar to the left side of previous Figure 16.1, the thoracic spine is most typically bent outward to the right as a direct result of the pelvis being tilted down to the right, due to the functionally and/or structurally high left leg. Also shown in Figure 21.1 is significant distortion of the chest, with obvious rotation axial rotation in the horizontal plane toward the left side.

It should be noted here that early anatomists considered minor right thoracic outward bending like that shown in Figure 21.1 and 16.1, which is like minor right thoracic scoliosis (which is seen in a stationary or standing state), to be the normal configuration of the spine[1]. This is important because it suggests strongly that this is the common thoracic pathology generally caused during running by shoe heels.

Although Figure 21.1 does not include a parallel picture of the runner's right side (Muybridge did not provide one), it is reasonable to assume it would be like the right side of Figure 16.1. That is to say, with level pelvis and no thoracic bending or chest distortion.

I think both Figures 21.1 and 16.1 provide a clear suggestion about the evolution of right-handers, who make up most of the population, about 92-93 percent. Because of this high percentabe, presumably both figures show right-handed runners (and probably with associated dominant right legs).

If so, then being right-handed clearly puts less structural stress on the heart, located on the left central part of the chest. As we have seen both figures, the greatest stress occurs during midstance of the left leg. The non-dominant, higher left leg forces the thoracic spine to the lower right leg, bowing away from the heart.

In contrast, if the right leg were structurally and/or functionally high, the thoracic spine would bow out to the left, putting substantial abnormal stress on the heart that right-handers would not be subject to. So evolution would favor our prehistoric forebears who threw spears with their right hands.

Better for Right-Handers, But Asymmetry Is Still Not Good for Cardiovascular Function

As shown in both Figures 16.1 and 21.1 above, functional and/or structural asymmetry in the frontal plane still distorts the entire chest area, including the left side with the heart, the terminus of an

elaborate network of arteries and veins. How exactly this affects normal function is unknown, never yet having been formally studied.

However, it is reasonable to conclude that the left area of the chest would be subject to abnormal compressive forces by the bowing out to the right of the spinal column. That would be in addition to the unnatural axial rotation in the horizontal plane that is also indicated clearly in the two figures.

These unnatural compressive forces in the frontal plane and rotational forces in the horizontal plane are likely to degrade cardiovascular function, especially over time.

The Shoulders and Arms Are Weakened by the Twisted Thoracic Spine, Predicting Cardiovascular Risk

Grip strength has been shown recently to be a very good predictor of risk for cardiovascular death, heart attack, and stroke. Unknown to researchers, the reason for this is likely that grip strength is logically a good marker for general and asymmetric weakness in the arms and shoulders caused by the twisted thoracic spine implicated in cardiovascular disease, as discussed above.

Lack of Support From Weak Lumbar Muscles Increase the Curve of the Thoracic Spine Unnaturally

Over time, the greatest degradation of cardiovascular function is like to occur in the sagittal plane. As shown earlier in Figure 19.8B, the increasing weakness with age of the abdominals, glutes, and hamstrings leads inexorably to increasing unnaturally the curve of the thoracic spine.

Among the elderly, the extremely stooped-over back – the classic dowager's hump – is quite noticeable. However, the increase in the upper back curve can be already quite advanced at a younger age, just less apparent.

The collapse inward of the chest in the sagittal plane causes significant additional abnormal pressure on the heart.

Lack of Cardio-Fitness and Obesity Are Factors in Heart Disease

The functional and structural disorders caused by elevated shoe heels significantly increase the difficulty and/or discomfort or outright pain from exercise. That reduces or eliminates the capability needed to exercise at a level sufficient to maintain a healthy heart.

Substantial asymmetry can make even simple non-rigorous exercise like walking difficult to perform, and even when it is fairly easy to do, the asymmetry reinforces itself during walking, worsening the asymmetry underlying the cardiac problem, and also producing pain during or after, especially in the elderly, making continued walking ever more difficult. It becomes a self-defeating cycle.

Inability to exercise adequately for the same reasons is also an obvious factor in the current obesity epidemic.

An interesting side note to obesity: obese men often are able to move somewhat more gracefully than you might expect, because their extra weight, especially if present from childhood, tends to force their

feet to pronate excessively, producing the same inward leg rotation and knock-kneed position much more typical of women than men.

This reinforces the early notion in chapter 15 that, between the two, the knock-kneed position provides better support than the bow-legged position in exercise and sports, judging from the leg structure of superior athletes .

23SCOLIOSIS IS CAUSED BY ELEVATED SHOE HEELS

Scoliosis is an abnormal, asymmetical curvature of the spine in the frontal plane, as shown in the example of Figure 22.1. Typically the pelvis is tilted and the spine curved in a “C” or “S” shape. It can result from injury, but most forms are idiopathic, meaning no cause is known.

When I examined the published research, there appeared to be an immediate direct linkage of characteristics to the typical form of running asymmetry described in Chapter 16 and shown in Figure 16.1.

The Same Basic Asymmetry Exists in Scoliosis as in Running

Most striking was a clear consensus that idiopathic scoliosis most typically involves right hip abduction (meaning rotated to the outside) and left hip adduction (rotated to the inside). As you recall, this specific hip asymmetry is exactly that which is shown in Figure 16.1.

The typical pelvic asymmetry is the same. The pelvis is rotated forward in the horizontal plane on the same side as the main thoracic curve, as shown on the right side in Figure 16.1

Also, muscular contracture of the right hip in the abducted, outwardly rotated position is typical of idiopathic scoliosis. That is exactly the relative outcome to be expected of the right leg shown in the right side of Figure 16.1.

This is because, as described in Chapter 16, the right leg remains fixed in the same position, tilted outward by shoe heel (that is, abducted) relative to the pelvis throughout the stance phase of running on the right leg.

The hip of the left leg is also contracted, but in the opposite, adducted (or rotated in) direction, as was the case in the running example of Chapter 16.

The right leg in both scoliosis and running is typically dominant. Scoliosis patients typically stand at ease only on their right leg.

The Femoral Neck-Shafts and Hip Sockets Show Deformity From Inward Tilting, Like In Running

Another piece of evidence from scoliosis research emerges that seems decisive. The neck-shaft angles of the femurs of scoliosis patients is much greater than normal, as shown in Figure 22.2.

Even more relevant, the hip socket is inset into the pelvis. These are precisely the abnormal adaptations you would expect to see resulting from supporting legs being tilted very far inward compared to the body's center of gravity.

As you recall from Chapter 16, the runner's right leg was tilted in at an angle of 11 degrees and the left leg at an extreme 20 degrees relative to the pelvis. And this is an apparently “normal”, asymptomatic runner, not a scoliosis patient.

The conclusion here is obvious, that scoliosis is an extreme form of pelvic and spinal asymmetry. But the extreme asymmetry of scoliosis is just the logical progression of the substantial asymmetry clearly observable in an apparently healthy runner whose body has been deformed from a lifetime use of elevated shoe heels.

Therefore, even apparently healthy runners show definite signs of the same basic asymmetric functional and structural deformities as do scoliosis patients.

Scoliosis Is Just the Earliest Manifestation In Life of the Effect of Elevated Shoe Heels

Scoliosis strikes early in life, during childhood through adolescence. What this means is that scoliosis victims are those who are most susceptible to the asymmetry effects caused by elevated shoe heels.

Because scoliosis strikes during the growth years, the asymmetrical effects of shoe heels on the structure and function of the human body are magnified. The victims of idiopathic scoliosis are simply those with the most innate asymmetry.

But those effects continue to develop in intensity throughout life, even for the vast majority who avoid scoliosis in its more acute forms. As we will discuss later, the effects of shoe heels again become magnified later in life, and become especially obvious among the elderly.

24 CERVICAL SPINE IS BENT AND TWISTED BY HEELS

The word “whiplash” when applied to injuries is particularly useful here in beginning an analysis of the effects of elevated footwear heels on the cervical spine. That is because the rough analogy of the spinal column to a whip is an extremely apt one in evaluating the unnatural effect of shoe heels.

If the lumbar spine is the handle and the cervical spine is the end portion of the whip, then the aptness of the analogy is that the motion of the handle is potentially magnified greatly at the end.

That is precisely the point I want to make. The lumbar spine is the base of the entire spine and controls the rest of it.

And the lumbar spine is unnaturally misaligned due to elevated shoe heels. As a result, the thoracic spinal also becomes misaligned, as seen in the elderly and in scoliosis patients. Only lumbar spine problems result in more hospital visits than the cervical spine.

But actually the most significant misalignment problems occur in the cervical spine, as we shall see. Although the cervical spine moves in all three dimensions, the most obvious potential problem is in the sagittal plane, at the back of the neck.

As shown in Figure 19.8A, a lessor curve is more natural and stable, but as the curve increases as shown in Figure 19.8B, so does abnormal instability.

I have not found research findings on the posture of the cervical spine in primitive, barefoot populations. But based on what I have carefully observed in elite athletes I would say definitely that a relatively flat, non-curved cervical spine is optimal.

The Cervical Spine Is Excessively Curved Backwards, Deforming the Rear of the Vertebrae

If, however, you look at a spine typical of modern shoe-wearing populations, as shown in Figure 23.1, two cervical anomalies stand out. First, the curvature appears to be greatest in the cervical spine, compared to the lumbar and thoracic.

Second, the spinous processes of the cervical vertebrae are located at the back of the spine are highly irregular, if not malformed compared to the spinous processes of the lumbar and thoracic spines. The back of the neck bones simply look deformed.

I think both of these anomalies are structural deformities of the cervical spine caused by functional and structural misalignments below, in the lower spine, pelvis and legs. Those misalignments being caused by shoe heels, as we have previously discussed.

The Larynx is Deformed, Affecting Speech, including Singing, and the Swallow Reflex

The most obvious probable outward effect in the excessively curved cervical spine is an excessively protruding Adam's Apple. That might seem trivial until you consider that it is the front of the larynx which supports the vocal cords. That suggests that you can't sing well because of a malformed larynx

that can be attributed to an adverse effect of shoe heels.

If this seems improbable to you, check out star basketball player Bobby Hurley's throat as he experiences extreme crossover effect in his right leg, as seen in Figure 23.2. This also helps to explain why exercise-induced laryngeal obstruction is common in athletes.

To take another example, a larynx problem which is perhaps of greater consequence in terms of life and dealth, especially to the elderly, is the swallow reflex. The anatomically complicated and delicate swallow reflex is likely to be adversely affected by the excessive cervical spine curvature that increases with age. When it doesn't work, the food you eat goes into your lungs instead of into your stomach.

Unnatural Structure & Function Increases Susceptibility to Whiplash and Other Accidental Injuries

To get back to the word that started this chapter, “whiplash” injuries usually describe violent accident injuries like car crashes in which the head is jerked backwards suddenly and with significant force.

The unnatural backwardly curved cervical spine is poorly positioned to resist such crash forces. Moreover, the anterior neck muscles are coincidently weakened abnormally.

Both abnormal factors further increase an unnatural tendency to accidental whiplash injury. It should be noted that this unnatural tendency to increase the severity of accidental injury is also generally true of all the adverse functional and structural effects of shoe heels already discussed in previous chapters.

The Risk of Stroke Increased By Cervical Spine Motion That Is Unnatural and Repetitive

The blood supply to the brain passes through a pair of vertebral arteries located inside the cervical spinal column and a pair of carotid arteries located in the front of the neck. The potential is great for any of these arteries, particularly those inside the cervical spine itself, to be increasingly pinched over time by the abnormal backward bending and twisting to the left of the cervical spine.

The routinely abnormal motion of the cervical spine has made it structurally far more delicate than is natural. As a result, accidental forces of a relatively minor magnitude are sufficient to cause temporary or permanent interruption of blood flow to the brain, causing transient ischemic attacks and strokes.

The result of a stroke is temporary and/or permanent damage within a hemisphere of the brain and loss of control and sensation of parts of the body of the opposite side.

25THE SKULL IS THE SKELETAL STRUCTURE MOST AFFECTED BY HEELS

By far, the most important and most adverse effect on the structure of the human body is that on the skull itself, which is balanced atop the atlas, the topmost bone of the cervical spine.

The skull is at the very end of the spinal whip. As a result, it moves the most, magnifying in all three dimensions the abnormal motions of the spine below it.

Unfortunately, the skull is located in effect at the business end of the spinal whip, where the whip is cracked. As noted above, the shoe-heel induced misalignments located below are greatly amplified at the topmost level of the skull.

Irony is also amplified. As we shall see, the largest number of adverse effects of elevated shoe heels are actually on the part of the human body that is farthest away from the feet. You probably did not see that coming.

Abnormal Skull Motion Occurs During Running, as Repetitive as Each Stride

The extent of the abnormal motions that can occur when running are illustrated in Figure 24.1, which shows a skull being torqued in all three dimensions. If these motions seem impossibly exaggerated, think again.

Famous photos of Roger Bannister and Jim Ryun setting world records in the mile both indicate abnormal head motion that is similarly exaggerated, as seen in Figures 24.2 and 24.3. While these head motions may seem extreme but also very occasional, I believe they are just strikingly exaggerated examples of highly common abnormal motion of a reduced but still significant and highly routine nature.

Lateral views of Ryun earlier in a race seem to show similarly significant asymmetrical head support between his right and left side support legs, but more subdued and more routine with every step, as shown in Figure 24.4. This is particularly noteworthy in the context of Ryun's health issues located within his head, which was impaired vision requiring correction with glasses and a hearing disability.

Abnormal Skull Motion Causes Virtually All of the Common Ailments of the Human Head

His known ailments lead directly to a very logical and important general conclusion. Namely, that the large number of human deficits located on or in the human skull are due to asymmetrical motion created by the obvious routine abnormal motion of the skull in multiple dimensions. In turn that abnormal skull motion is caused by elevated shoe heels disrupting the natural structure and stable function of the human body below the skull.

For example, a partial list of medical deficits located in the head includes, besides any vision or hearing deficits, including eustachion tube and other infections, asymmetrical nasal passages like deviated

septum and other sinus problems including headaches, snoring, facial asymmetry, dental problems including jaw bite position problems (like over-bites, under-bites, and cross-bites), as well as teeth asymmetries like crooked, crowded, gapped, or impacted teeth.

The list goes on, but the short answer is everything in the head that is structurally or functionally asymmetrical is likely due to the human head being tossed around unnaturally at the end of an abnormally formed spinal whip. Being bent backwards and bent sideways and twisted unnaturally, all together these abnormal positions expose the skull's contents to abnormal, highly repetitive forces of the maximal amplitude normally experienced by the body, all due to elevated shoe heels.

Vision Illustrates the Structural and Functional Problems Within the Abnormally Supported Skull

Just consider vision as an example. The most common modern problem is short-sightedness (myopia), which results from an abnormal elongation of the eye.

If the skull is typically bent backwards as noted by the excessive curve of the cervical spine, then the new, more downwardly directed force of gravity is going to increase pressure on the back of the eye. That gradually lengthens it over time (and continues over time), moving the retina at the back of the eye backwards and increasingly out of focus.

If the skull is bent sideways too, then that creates asymmetry between the right and left eyes. Add in twisting motion as well, so the abnormal skull motion is in all three dimensions. The result is asymmetry within either or both eyes (astigmatism), and well as different levels of myopia in each eye.

Similar mechanisms are at play for the all the other deficits inside and outside the skull that were listed above. Of course, as usual, there are no known direct causes for any of these listed head-centric problems. By default, the accepted current wisdom is that they all just happen.

The Nearly Full Size of the Five Year Old's Brain Exaggerates the Instability Problem of the Skull

The weight that must be carried within the skull of a five year old human child is proportionately much greater than a fully grown human like Jim Ryun in the figure shown above. That is because the five year old child's brain is nearly adult size, even though the child is much smaller.

On a relative basis, this means the child's neck muscles are overloaded compared to an adults, making it relatively much more difficult for the child to stabilize successfully the abnormal motion of his or her skull caused by elevated shoe heels. That would unfortunately increase the likelihood of all the skull-located physical problems discussed above, tending to make them all worse.

26HUMAN BRAIN STRUCTURE IS CHANGED BY SHOE HEELS

It follows directly from the last chapter on the skull that the brain, the largest organ within the skull, would be unnaturally altered by the abnormal motion of the skull. And just like all of the other contents of the skull, the unnatural alterations are caused ultimately by elevated shoe heels,.

If this sounds incredible to you, as it did to me initially, it is reasonable to be skeptical. After all, it does seem far-fetched to think that a very innocuous heel feature of lowly shoe soles could change the structure and function of the lofty human brain.

Especially hard to believe since they are separated as they are by the entire human body. Still, the logic and evidence from all the preceding chapters points directly to that incredible conclusion.

The Smoking Gun Showing Structural Change Between the Brain's Right and Left Hemispheres

In addition, there is what may be a smoking gun. At least regarding a definite structural change in the anatomy of the brain.

Most of the human brain, the portion that is more recently and most highly evolved, is divided into right and left hemispheres. And as you would expect from the preceding chapters, the two hemispheres are unquestionably asymmetrical, as shown in Figure 25.1.

Ironically, the horizontal lower surface view of the brain illustrated in the Figure clearly shows the twisted structural effects of the same kind of abnormal rotary or swiveling motion we first saw in the tibial plateau of the modern knee, as compared to the “primitive” knee (Fig. 3.4)

Unfortunately, we have no comparable brain from a barefoot, primitive population for comparison. But if we did, it is logical to expect the “primitive” brain to be structurally symmetrical, like the knee joint of the same population.

In addition to the twisted asymmetry between hemispheres, the unnatural modern brain has larger cells with longer range connectivity in the left hemisphere compared to those in the right hemisphere.

Modern Brain Asymmetry Is the Same as the Pelvic and Spine Asymmetry Indicated by Running

As you recall from Figure 16.1, under the high left support leg, the pelvis is tilted down and rotated forward on the right side. Forced by this abnormal position of the pelvis directly supporting it, the spine is bent to the right and rotated forward on the right side.

The modern human brain shows the same forward right side asymmetry. As seen in Figure 25.1, the right hemisphere of the brain is rotated forward, just like the pelvis, and the left hemisphere is rotated backwards, also just like the pelvis.

Moreover, the hemispheres are clearly rotated into each other's natural, symmetrically parallel

locations. The forward section of the right hemisphere is shifted past the edge of the forward left hemisphere. And the posterior left hemisphere is clearly shifted all the way into the posterior right hemisphere's natural position, again as seen in Figure 25.1.

The Known Functional Differences Between the Right and Left Hemispheres of the Modern Brain

Split brain research in the past few decades has revealed that language and mathematical skills are primarily located in the left hemisphere of the modern human brain. The left hemisphere seems to provide sequential analysis of component parts.

In contrast, the right hemisphere is viewed as holistic and parallel in processing. It is better at spacial representations and global processing.

The rough analogy this research calls to my mind is that the left hemisphere is more like a general purpose processor of a computer and the left hemisphere is more like the specialized graphics co-processor(s).

To carry on with this computer hardware analogy, the general purpose processor of the left hemisphere is also the master or central controller of the computer brain. A leading neuroscience researcher of split brains, Michael Gazzaniga, has named this left hemisphere controller the “interpreter”.

To complete this general picture of the brain, the left brain hemisphere directly controls the (usually dominant) right side of the human body. About 92-93 percent of the modern population is dominant right-handed, and usually right dominant leg also.

What does the Unnatural Twisting Do to the Function of Right and Left Brain Hemispheres?

I could find nothing in the research on the right/left structure or function of the brains of primitive barefoot populations, so there is no way to directly compare them with modern brains to examine the differences.

However, it is possible to logically describe the probable impact of the asymmetric changes present in the hemispheres of the modern brain.

For example, with the left leg load-bearing and pelvis tilted down to the right, as seen in Figures 21.1 and 16.1 (left side), the position of the head is going to be twisted to the left and downward. The head would return to normal natural position under the right support leg with level pelvis.

The repetitive pressure that results in the twisted hemispheres would also put gravity force pressure on the forward portion of the right hemisphere, in the area of the prefrontal cortex. This is because the right side of the head would be lower than the left side.

Growth of the Lateral Prefrontal Cortex is Retarded in the Right Hemisphere and Enhanced in the Left Hemisphere

Such abnormally higher peak pressure would tend to retard physically the natural brain development in

the lateral prefrontal cortex of the right hemisphere. In contrast, on the left side, the peak pressure would be abnormally reduced, tending to enhance natural brain development in the lateral prefrontal cortex of the left hemisphere.

The larger cell size and greater long range connectivity of the left hemisphere already noted supports this conclusion. With such enhanced relative development in the left hemisphere, it might play a significantly more dominant role in the abnormal modern brain compared to the natural primitive brain.

This change is potentially extremely consequential, since the affected lateral prefrontal cortex of the human brain is its most highly developed portion, wherein the most advanced level of thinking occurs.

The language and mathematical skills primarily located in the left hemisphere would likely be enhanced, albeit abnormally. And at the expense of reduced skills in the right hemisphere.

In other words, the abnormal modern brain may well have become more dominantly linear or sequential and analytical than the natural primitive brain.

The Backward Tilted Cervical Spine Weakens the Neck, But Enhances Development of the Prefrontal Cortex

In addition, the excessive cervical spine curvature typical of the modern spine tends to tilt the skull and head backwards abnormally, also as noted before. This weakens the neck and encourages whiplash injuries, making the head and brain much more delicate.

Tilting the head backwards abnormally not only inherently increases the force of gravity pressure on the posterior portion of the brain. It also decreases it in the front portion, in the area of the prefrontal cortex.

The result would be enhanced development of the critically important upper or dorsal prefrontal cortex of both hemispheres and its capacity for the most advance level of reasoning.

The Opposite Effect Of Tilting the Head Far Forward In the Elderly May Be a Cause of Dementia

The extremely abnormal curvature of the thoracic spine late in life, the classic dowager's hump, causes the head to tilt forward, eventually progressing to a standing and walking posture wherein the face is pointed 90 degrees down, abnormally facing directly at the ground instead of naturally straight ahead. As noted previously in chapter 22, the abnormal extreme curvature of the thoracic spine is caused by elevated shoe heels.

This unnatural position puts substantial abnormal pressure on frontal cortex of the brain, the site of the working or short term memory. Impairment of short term memory is of course a classic sign of dementia

The Net Abnormal Development Effect on the Unnatural Modern Human Brain

So the net abnormal motion of the head is to be tilted backward and twisted to the left. The net effect

of that abnormal motion on the unnatural modern brain is therefore to abnormally enhance the development of the dorsal lateral prefrontal cortex in the left hemisphere.

The dorsal prefrontal cortex enhancement has occurred in the right hemisphere because of the backward tilting, but much less due to effect of abnormal twisting to the left.

The dorsolateral prefrontal cortex of the left hemisphere therefore becomes even more dominant as the single, all powerful CEO of the brain. A CEO with enhanced language and mathematical capability at the highest level of human reasoning, including the unique human capacity to model and plan the future.

The Computer Analogy Again

To revisit the computer analogy, the abnormal modern human brain may more like a uniprocessor supercomputer. And less like the dual processor parallel computer it has been throughout its earliest evolution up until new modern version.

It may well be that throughout its evolutionary development in mammals the dual hemisphere brain has been optimized predominantly on the central binary problem of fight or flight. That would require a quick decision and fast reaction that the dual hemispheres would excel at, with the additional benefit of increased backup durability in the form of redundancy.

The totally ad hoc, happenstance design of the abnormal modern brain therefore logically seems to enhance the highest levels of human mental processing. But at the cost of much greater fragility and loss of redundancy.

Physical Activity (With Shoe Heels) Increases Brain Hemispheric Asymmetry, Improveing Cognitive Function

Recent neuroscience studies indicate that higher level brain function is asymmetrically located in the prefrontal cortex of the left or right hemisphere of younger people, particularly the left dorsolateral prefrontal cortex. In contrast, both hemispheres typically are involved in people over 40, who also tend to have much less physical activity, especially in the form of running. This could be interpreted to mean the activity of the brain is reverting to a more natural, symmetrical state with age. However, most neuroscientists refer to this reorganized state as a weakening.

In a new 2016 study of elderly men by Hideaki Soya, those who were more aerobically fit typically used just the dorsolateral prefrontal cortex of their left brain hemisphere for higher level tasks. Less aerobically fit elderly men used both hemispheres for the same high level tasks. Again, this strongly suggests the physical activity with ubiquitous elevated shoe heels causes brain hemispheric asymmetry and that brain asymmetry apparently is functionally beneficial.

No Such Modern Brain Change Could Be More Odd or More Ironic

Irony has often been substantial many times here in earlier chapters, but there can be no greater irony

than this: **elevated shoe heels have had a catastrophically bad effect on the structure and function of every part of the human body - except the brain, the highest functions of which shoe heels have enhanced!** All this happening strictly by chance.

It cannot get odder than that. In short, a better brain that is barely balanced on a broken body, a body that is far less robust or healthy.

A Challenge to That Contradictory Outcome of Better Brain But Broken Body

There is another odd fact to fit into this overall picture, specifically relating to the brain. It has been reported that the human brain has shrunk by about 10 percent over the last 5,000 years.

This fits in with a narrative of mankind's transition from hunter-gatherers to farmers based on the theory that farming is a much less cognitively difficult task that allowed the human brain to atrophy measurably.

That narrative piggy-backs on the analogy of the transition of the wolf into the dog, wherein the wolf apparently has been measured to have a slightly larger brain, presumably because hunting in packs is more cognitively challenging than wagging your tail to get a handout.

Actually, the latest research indicates that dogs among all animals, including even our closest relatives the chimpanzees, are supremely adapted to interact effectively with humans. So even the basis for the analogy is questionable. Nor is it unquestionable that farming is less challenging than hunter-gathering.

Nor is it likely that we have any very reliable information on human brain size 5,000 years ago, only on skull size, which is not at all the same thing. And any minor skull size reduction may be more directly related to the related reduction in jaw and teeth size that occurred in that time frame, although even there the change may be more directly to the increased use of fire for cooking.

At any rate, I believe it is at least possible that a 10 percent shrinkage of the human brain, if it did in fact happen, many have occurred mostly much more recently, like within the last 500 years or so. And that whatever shrinkage occurred may have been primarily due to being exposed to highly unnatural extremes of motion due to its position at the working end of an abnormal spinal whip caused by elevated shoe heels, as discussed in the previous chapter and this one.

27THE RENAISSANCE, THE REFORMATION, & THE RISE OF MODERN SCIENCE AND TECHNOLOGY

If the abnormal modern brain is really better, are there any real world effects that positively demonstrate that improvement? It is not clear how that question might answered in any acceptably definitive way at the present time. Too much new research needs to be done.

But there is an intriguing correlation that can be considered now that suggests the possibility of knowing what a "better modern brain" might mean in terms of real world effects. The Renaissance (14th to 16th Centuries), the Reformation (16th Century), and the introduction of various forms of footwear with elevated heels to Western Europe from the Orient and the Near East[1] - all three happened around the same time.

A number of higher heeled footwear, mainly varieties of platform shoes, began appearing near the start of the 14th Century in Venice, the center of East – West trade. Heeled shoes more similar to modern types appeared in Western Europe from Persian horseman in the late 16th and early 17th Century. Unfortunately, the available information, particularly on extent of usage, is extraordinarily limited.

By the late 17th Century, the men of the upper class had widely adopted relatively high heeled shoes, typified in a famous portrait of King Louis XIV of France with relatively high red heels. After the French Revolution at the end of the 18th Century, higher heeled footwear became less popular with men, but more widely adopted then by women.

Unfortunately, it is essentially impossible from the very sketchy historical record to say exactly what footwear exactly was being worn by whom and when. And doubly impossible to correlate that information with specific important milestones of the Renaissance and Reformation.

For example, the invention of the printing press by Johann Gutenberg in 1455 almost certainly had the greatest single effect of anything on both the Renaissance and Reformation. Whether Johann was wearing footwear with elevated heels at the time he invented the printing press is unknown.

Similarly, Isaac Newton (1642-1727), probably the greatest scientist of the era, is shown wearing elevated heel footwear, but in an 1874 print, so it could well be an anachronism. So again, no reliable information.

Unknowable For Now Whether Elevated Shoe Heels Had a Role in the Rise of Modern Science

At this stage, and maybe forever, it is unknowable whether elevated heel footwear played a causative role in the creation of modern science and technology, or merely happened at about the same time.

Still, it is undeniably intriguing that the otherwise completely adverse effects of footwear may have had a leading role, or even the leading role, in creating the modern world.

And, if so, it is obvious that modern science and technology have brought vast general improvements in

health care and in standard of living in the modern world. As one unequivocal measure, life expectancy of the general population has increased dramatically compared to five centuries ago.

On that basis, elevated shoe heels have been a huge net benefit to human health.

28UNIMAGINABLY HIGHER MEDICAL CARE COSTS

However, the other side of the coin, literally, is the health cost of the medical damage caused by elevated shoe heels. There the news is quite the opposite.

The annual cost of health care in the United States is about $3,000,000,000,000 or $3 trillion. Of that total, about one third is clearly attributed to the direct adverse effects of elevated footwear heels, or about $1 trillion a year in direct costs. This would include, for example, osteoarthritis.

In addition, about one third of the annual total of $3 trillion is attributable to the indirect or difficult to trace adverse effects of elevated shoe heels. Of that $1 trillion, about half or $0.5 trillion is due to indirect adverse medical effects of elevated shoe heels.

This would include, for example, greater susceptibility, intensity, or duration of infections due to reduced effectiveness of the immune system caused by malformed and poorly supported internal organs.

The U.S. Health Care Costs for Adverse Medical Effects of Shoe Heels Is $1.5 Trillion Annually

In total, then, about half of all U.S. health care costs, about $1.5 trillion, are attributable to the adverse medical effects of elevated shoe heels. I believe this is actually a conservative estimate.

At this early stage where it is difficult to pin down specifically the component costs accurately, it may be more appropriate to convert to an estimated range, which would be from $1 trillion to $2 trillion. Although that range of error is great, even the low end obviously is a huge number.

Worldwide, the cost of health care is a little over $10 trillion. That total includes for third world countries with lower standards of health care and cost, as well as less use of modern footwear. This is even more of a guess than an estimate, but I think the third world portion is roughly $2.5 trillion of the non-U.S. portion of the total cost.

Worldwide Health Care Costs for Adverse Medical Effects of Shoe Heels is $4.5 Trillion A Year

So the total annual worldwide health care cost for the adverse medical effects of elevated shoe heels is about $4.5 trillion annually, including $1.5 trillion for the U.S. and $3 trillion for non-U.S.

The global footwear market is about $300 million for 2015. That means that, worldwide, the adverse medical effects of footwear with elevated heels is roughly 15 times the cost of the shoes themselves.

So the global health care cost of a $100 pair of shoes is $1,500. In the U.S., with pricier athletic shoes, the cost is probably twice that or even more. This situation is, of course, completely insane!

If the Cause Is Not Eliminated, All You Can Do Is Treat the Effects

The worst thing about these enormous medical costs is that they are all going to treatment of the adverse effects of elevated shoe heels. Besides costly, that is ineffective. Now that the actual cause has

been identified, eliminating all those costs through early prevention is the only rational approach. That has to be the goal. Otherwise, “medicine [is just] failed prevention.”[1]

29QUALITY OF LIFE SEVERELY REDUCED

In contrast to cost, it is difficult if not impossible to quantify the reduction in quality of life caused by elevated shoe heels. But at least on a relative basis, it is clearly lower for nearly all, especially for the elderly and disabled.

To the extent that their body has been deformed by elevated heel footwear, all modern humans throughout their entire lives suffer from a reduced quality of life, possibly substantially reduced, compared to what they would have been able to do physically. Put plainly, their bodies would have less wrong with them. Doing anything would be physically easier.

Certainly, for the elderly and disabled, the loss in their quality of life is relatively much greater, since the adverse effects of shoe heels is progressive. At the later stages of life, the adverse effects begin to peak, commonly resulting in very stooped posture and even significant structural problems like “dowagers hump” back and inability to hold up the head when walking.

Indeed, maintaining the capability of ambulating is probably the single most important requirement to maintain health late in life. And the lifelong adverse effect of elevated heels most directly attack that capability.

30NEW RESEARCH IS THE HIGHEST PRIORITY!

My research has been long term, in depth, and very careful, but severely limited simply by a gross lack of available information that is publicly available, even with considerable effort. Added to that, I have had the personal advantage of close periodic proximity to the National Library of Medicine and the Library of Congress. Furthermore, lately I have had fairly frequent assistance from a conscientious intern who was willing and able to go to those libraries to dig up all the stuff that is unavailable on line, including a lot of the older or more esoteric studies.

In sum, at this stage I have pretty much plumbed the depths for what is publicly out there of relevance to this research. By publishing this work I hope to be informed by others of whatever I may have missed.

Assessment and confirmation of my principal findings and conclusions by qualified experts in relevant fields is the next logical step. They need to consider the wealth of non-public information that is easily available only to them, either in collections they oversee or that they can evaluate in the field without undue difficulty.

For certain, there is a vast amount of useful, perhaps definitive information in existence that was not publicly available to me. To give just one example, in Great Britain there are many collections of skeletal remains from hundreds of Anglo-Saxon and earlier grave sites that could be evaluated by anatomists and physical anthropologists for comparison with bones of modern native Britons. Comparing tibial plateaus, particularly for both legs when possible, would be particularly useful.

All over Europe - the Paris Catacombs being another example - there are similar medieval and earlier grave sites that have yielded a large number of collections of intact skeletal material. Egyptian and other mummies are another obvious potential source among a vast multitude of other sources.

That skeletal material can be reasonably presumed to be from those who have not worn elevated heel footwear. Unfortunately, what footwear may have been worn is essentially impossible to know for sure. Some types of footwear in ancient and medieval times such as platform shoes and stilted clogs did have elevated heels, though not in their modern form. Bones survive over time much better than leather or wooden footwear.

Another example focus of research is carefully evaluating any living humans who have remained barefoot during their lives. One possible source is in the South Pacific Islands, where life does not require footwear. I once worked for a native Hawaiian who did not wear shoes until he went to college at Northwestern University, where footwear was mandatory in the Chicago winters. Modern medical technologies like MRI provide an excellent, detailed and safe window in the inner structure of living human bodies that did not exist until relatively recently.

31WHAT IS THE NEXT STEP?

Given the severe damage to the human body done by elevated shoe heels, what can be done the fix the existing damage? Or is fixing existing damage even possible?

On a more positive note, it would seem we can without question avoid future damage starting at birth by simply avoiding elevated shoe heels. I also have good shoe sole designs that neutrally preserve the biomechanics of the barefoot. But how do we do that without losing the apparently critical enhancement to the human brain created by elevated shoe heels? For that I have no certain answer.

These are all extremely important questions. As probably the only person currently who might know the answer to any of those questions, I can say, regretfully but unequivocally, that I cannot answer any of those questions with a satisfactory level of certainty.

It Is Not Clear How to Fix Shoe Soles to Limit Or Fix Existing Structural Damage

I have tried for many years with limited technical means to fix the basic problem at the source, namely, the shoe sole. As I have said earlier, eliminating the shoe sole entirely and going barefoot is definitely not a good general option, if you already have existing damage, as most do. Going barefoot even makes the damage worse.

For many years I have played around with rebuilding or modifying shoes, shoe inserts, and insoles, both prescribed and over the counter, and gotten nowhere. I actually have many shoe boxes filled with inserts that I custom made for myself to test treatment solutions for my own specific asymmetry problems. As far as I could tell, none worked.

I eventually gave up, although I still can't resist trying out brilliant ideas from time to time, but nothing has ever worked. And I have always known the reason for the consistent failure, more or less.

Far Too Many Variables to Control

There are just far too many variables in terms of what you can do to the both the right and left shoe soles or insoles or inserts. And the sensitivity of my ad hoc measurement of improvement or lack thereof was not delicate enough to measure minor incremental differences.

Although my methods were pretty crude, the same essential problem exists in the best equipped biomechanics labs today. There are too many variables to control for and they are are too difficult to measure accurately except in very limited ways. Because of this, the general situation is that too few test subjects are used in the tests and too few trials are run for each test subject.

However, recent advances in a very popular new technology have provided a whole new approach that appears to solve all of these interminable problems. If fixing the existing damage to human bodies by shoe heels is possible – a big if - this new approach should be able to find the way.

And if it is possible to fix or avoid damage while at the same time still maintain the brain enhancement

provided by shoe heels, this new approach should also be able to find the way.

In addition, there is some other hope of a solution to the difficult questions with which this chapter began. After all, many individuals have minimal damage despite wearing conventional modern elevated shoe heels. Identifying their unique accommodation, such as lower main longitudinal arches, may provide a fruitful approach that can be implemented in shoe sole design.

32CONFIGURABLE SOLE STRUCTURES CONTROLLED BY SMARTPHONE AND/OR CLOUD

The smartphone is poised to revolutionize medical care. A super powerful personal computer located on or near your body almost 24/7 that connects to the Internet and with sensors directly on your body provides a previously unheard of potential for health care monitoring and direct, realtime treatment.

The overall picture of this relatively imminent medical future was laid out in detail this year in a book by Dr. Eric Topol titled, "**The Patient Will See You Now**". The title emphasizes his view that in that future the patient will have far more control of his own personal health care than is the case now.

The smartphone will also revolutionize medical care in a way unforeseen by Dr. Topol. The smartphone has the capability to answer the difficult questions raised in the last chapter, if they can be answered.

In short, the smartphone is the key component in a system that actively monitor sensors in your shoe soles and on parts of your body like the small of your back (roughly, your body's center of gravity) and your head. The smartphone can then use that information to evaluate and control electronically configurable structures in your footwear, correcting and optimizing in real time your body's personal biomechanics while running or walking or just standing around.

To put this into proper context, the capabilities and potential benefits just described of this invention combining smartphone and configurable footwear soles goes very far beyond anything that can be done today for you or anyone else in even the most sophisticated and best equipped footwear biomechanics lab anywhere.

Moreover, the smartphone can connect to a web-based cloud computer system that can compare your data with that of others using the same system, which could easily become a database of millions of users. Big data techniques can then be used on all that data to find important correlations for you and others physically like you that would be impossible to spot any other way.

Reliable solutions to structural and/or functional problems that many others have already had that are the same as your problems can be downloaded from the cloud to your smartphone. The smartphone can then use the solution to configure your footwear soles.

The whole process of the cloud/smartphone/footwear system would be ongoing continuously. It thereby continually optimizes corrections to existing damage you may have from elevated shoe soles.

The Invention Solution Has Already Issued in the Form of U.S. Patents

Of course, I am an inventor. It occurred to me several years ago that only possible solution to the catastrophic human damage from shoe heels that I was uncovering was this kind of smartphone approach.

So I filed U.S. and international patent applications, and received my first U.S. Patent on this technology, Number US 9,030,335, on May 12, 2015. It is available on the Internet at my website: **anatomicresearch.com** or at the USPTO website.

I was completely taken by surprise about a month later when my business partner's wife told me that she had, strictly by chance, run across a highly laudatory **YouTube** video complete with animation on my brand new patent. The patent was singled out from many thousands for praise. You can see it by Googling the title, "**Smart Shoe – finally humanity invents the shoe that it deserves**" or you can go directly to the link: **https://www.youtube.com/watch?v=CjBhghWDMoM.**

In the short time since then, I have already received three more U.S. patents on specific aspects of the new technology, such as for a smartphone app and for using a web-based cloud. Those three are Patent Numbers US 9,063,529, US 9,100,495, and US 9,207,660 – all available at my website: **anatomicresearch.com** or at the USPTO website.

Tuning Both the Body and the Brain Optimally

This new technology holds the potential for finding the best solution in real time for correcting the major anatomical misalignment in your body. That in itself is impossible with any other existing technology. But this new invention may be able to do even more.

At the same time it tunes the performance of your body, it similarly holds the same potential for tuning the performance of your brain. Specifically, for example, tuning the enhancement of the development of the dorsolateral prefrontal cortex of the left hemisphere of your brain.

It may be able to do what otherwise would seemingly be impossible. It may be able to find the best possible compromise between otherwise contradictory goals. That is, it may be able to correct the major misalignments of your body while still maintaining the full enhancement of your brain's left hemisphere dorsolateral prefrontal cortex. Or at least the best optimization compromise, or range of compromises, between the contradictory goals.

33 ANATOMIC RESEARCH INSTITUTE

I am well along in my relatively successful invention career already. And I am optimistic as to future income from sales of this and other books, primarily on topics relating to some other significant problems of existing modern footwear.

So I think I can afford to be fairly altruistic concerning the patents I described in the last chapter, as well as my now rather large portfolio of other footwear patents, many of which are of a closely related nature. Most relate to better performing, truly barefoot-like footwear and to computer control of configurable structures in footwear soles, like air bladders, compartments, and chambers.

A Non-Profit Anatomic Research Institute Holding My Patents

My plan is to establish a non-profit Anatomic Research Institute and transfer all my footwear patents to that Institute. They all will then be available for non-exclusive licensing to any footwear company.

I do not plan to charge licensing fees, but I do expect to receive substantial supporting donations from well established footwear companies to fund the effort of the Institute to coordinate the best footwear, medical, and other solutions to the serious medical damage caused by existing footwear products.

I believe they will contribute at a reasonable level because it is firmly in their best interests to do so. With an irony that will not be lost on their customers, shoe companies can expect enormous potential financial benefits by marketing demonstrably better products needed to fix the problems their previous products created.

It is also in their interests in terms of avoiding problems that could arise from an inadequate or non-credible effort limited to the private sector. That might prompt an over-reaction in the government sector, such as footwear being declared medical devices by the FDA. In the absence of effective, proactive effort by the industry, the FDA could make a compelling case to do so (despite, of course, having itself no existing experts or expertise to regulate footwear in any way relevant to the issues raised in this book).

More than anything else, the entire footwear industry is going to need to establish a new fundamental basis for trust by the public that the industry knows what they are doing with their products in the future. This book indicates that their past track record at best is total ignorance of the problem, so believing in solutions that they come up with on their own are not likely to be well received by the public or by government regulators.

I plan to recruit a CEO from the medical community to lead the Anatomic Research Institute. I am already well aware of who are the leading researchers in medicine, biomechanics, physical anthropology, podiatrics, and other related fields because I have been using their research studies extensively. I plan to recruit them as consultants or staff members depending on their personal circumstances.

A small group of the best of them will form a board of advisers that will also include a few representatives from the footwear industry. The board of advisers and I will provide overall research direction.

The foremost missing factor from the research equation right now is relevant medical expertise, which is completely lacking in the footwear industry. My primary goal for the Anatomic Research Institute is to add that critical medical foundation to the effort to find solutions.

A Major Medical Research Effort – Like the Race to the Moon

I believe what is required now is a major medical research effort, one of unprecedented scope. Although the term is inappropriately and over used, what is required is a moonshot that gets off the ground quickly. Compared to the Apollo moonshot, the tangible payoff on Earth would be far greater, as well as both much cheaper and faster.

What is required is as follows. First, the major issues I have raised as to our current probable misunderstanding of human anatomy must be resolved as quickly as possible.

Second, the damage caused by elevated shoe heels needs to be accurately assessed for every part of the human body. Third, the most effective medical and other treatment plans must be devised. Fourth, since every age group is affected more or less by the progressive adverse effects, the treatment plans must be tailored for definable groups.

Besides added a crucial medical focus, an approximately equal priority for the new research institute is to drastically increase the support and participation of biomechanics scientists. As a group, they have the most relevant expertise necessary to implement successful solutions, particularly involving footwear and motion. Almost all of them currently subsist at academic institutions with very limited funding and little outside support from the footwear companies.

It strikes me as extraordinarily odd that there are probably about 100 neuroscientists currently for each biomechanics scientist. Yet those few biomechanics scientists may have far greater impact on improving the actual functioning of the brains of living humans over the next decade or two. I'm not arguing for fewer neuroscientists, only for many more scientists with expertise in biomechanics and lower extremity human anatomy.

At any rate, my personal goal and that of the Institute will be research and development only. The development will go only so far as creating prototype soles with the cooperation of the industry. Those prototypes would then serve as the simplest possible basic standards that can be safely copied and used within the industry to build actual products for market. Associated with the prototype soles would be a limited testing program.

The Basic Tool: Smartphone & Cloud Control of Configurable Structures in Footwear Soles

I believe the most likely and best footwear solution will come from using the smartphone and cloud-connected footwear soles with configurable structures that are microprocessor-controlled, as discussed

in the previous chapter.

They will provide all the data on an individual wearer basis needed to solve the problem and they can then also implement the best solution available at any given time for large populations. And over time, the solutions can continuously improve as the big databases improves.

There is tremendous potential in collecting this individual data and matching it up with other individual medical data, including widespread individual genetic testing in the future. The result of using all this combined data on individual health care is likely to be revolutionary. And aggregating it in the cloud with the data from millions of other individuals is likely to be truly revolutionary.

Lack of Privacy and Security of Highly Personal Data in Smartphones & the Cloud - An Insurmountable Problem?

There is however a major roadblock to this highly promising approach. There exists no way to safely create and store this extremely personal data, not currently and not in the immediate future.

The continual theft of huge databases from both businesses and government provides constant proof of this never-ending problem. Your smartphone and personal computer similarly lack reliable protection.

The seemingly insurmountable problem is reliable cybersecurity does not currently exist and is not even theoretically possible using existing methods. But a basic change at the most fundamental level can provide a practical solution, as we will discuss in the next chapter.

34HARDWARE IS THE MISSING LINK IN CYBERSECURITY

A new hardware-secure architecture for computers that, for the first time, provides true security and privacy for computers that are connected to the Internet.

Cyber security has become so bad that it now poses an extraordinarily grave threat to the U.S. economy and our national defense. No comprehensive solution to this threat has been found, much less implemented.

Nor will there ever be using existing methods, because reliable security is theoretically impossible with the existing computer architecture.

The existing Von Neumann architecture for computers was designed in 1945, several decades before networks were invented. It has no reliable internal defense against Internet malware. Only software defenses are available internally, which inherently can be defeated by software malware.

The only reliable existing alternative is to disconnect the computer from the Internet. But Internet connection is absolutely mandatory in today's world. A smartphone without a signal is nearly useless.

Unfortunately, Internet connection requires that computer external defenses like firewalls be porous, thereby potentially allowing in malware, which can potentially go anywhere inside and do anything.

The best that can ever hoped for with existing Von Neumann architecture is an endless, continual battle between internal software defenses and offensive Internet malware software.

In the end, the defense always looses, because it has to be perfect every time in every battle. Otherwise the defense loses the war. The offensive malware software only has to win one small battle, even a minor skirmish, to win the entire war.

Just like in biology, one tiny software virus can kill. But unlike biology, computer hardware can provide an absolutely invulnerable defense against software.

A new computer architecture has been invented that provides an internal hardware defense against Internet malware software.

The new architecture provides an inner protected area with a master controlling microprocessor that controls the entire computer through a secure control bus that is not connected to the Internet.

The inner protected area can be disconnected from the Internet by a simple impermeable

hardware barrier. It therefore can be completely invulnerable to Internet malware software.

The new hardware-secure computer architecture manages to do what is seemingly impossible currently. It is simultaneously both Internet connected and Internet disconnected.

It thereby provides the fail-safe security and absolute privacy that are impossible now with current methods that are doomed to fail, sooner or later.

The new secure architecture can be used in any Internet-connected computer, from the simplest to the most complex, from the Internet of Things devices to smartphones to clouds and supercomputer arrays.

Additional information on this new secure computer architecture technology is available on my website: **glonetcomputers.com**.

35OVERVIEW OF THE NATURALLY FORMED HUMAN BODY

The unnatural forces acting on the human body equipped with elevated shoe heels have an overall effect on the basic proportions of the abnormal human body. This is an unproven hypothetical conclusion, but supported by the logic outlined in previous chapters.

The unnatural alignment of the lower limbs caused by elevated shoe heels increases forces unnaturally on bones, restraining growth according to Woolf's Law. The result is proportionately shorter legs.

The misalignment of the abnormally widened pelvis causes weakened abdominals, gluteus maximus, and hamstrings thereby weakens generally the trunk. That decreases forces on the spine and encourages growth, again according to Woolf's Law. The result is a proportionately longer spine and trunk.

The effect on the cervical spine is particularly noticeable, resulting in a longer neck. The weakened trunk also provides an unstable, misaligned base of support for the arms, resulting in shorter arms and narrower shoulders proportionately.

An Overview of the Natural Human Body, Without Modern Malformation Defects

The natural human body, unaffected by abnormally elevated shoe heels, should demonstrate proportional characteristics that are the opposite of those described above for the abnormal human body equipped with modern footwear.

Therefore, by the same logic used above, compared to the abnormal human body as we currently know it, the natural human body would have proportionately longer lower and upper limbs, as well as a shorter trunk and spine.

The pelvis would be less wide and less flattened, and the shoulders wider. Because muscles and joints would no longer be misaligned with its naturally correct physical form and structure, all of the muscles of the body would be better developed and the whole body much stronger.

Naturally Correct Function Follows Naturally Correct Form

The reciprocal of the famous design aphorism, “form follows function”, is “function follows form”, which is just as true. Actually, the enhanced reciprocal aphorism should be “natural function follows natural form”.

With a naturally correct form, function becomes naturally correct as well, instead of abnormal and prone to disease and injury. So there should be a major general increase in health and quality of human life.

While this improvement should be dramatic at all stages of life, the difference is likely to be most remarkable in the elderly. The last stage of human life should improve to generally good health and a

quite satisfactory quality of life, instead of years of severely handicapped existence involving substantial pain and suffering.

This is very important since life expectancy is likely to increase based on other improvements in medical care, as well as based on natural form and function.

An Increase in Life Expectancy for Men to Equal That of Women?

As noted earlier, the differences between men and women have been substantially exaggerated in an unnatural way by elevated shoe heels. One of the most important of those differences has been in life expectancy, which has increased from a couple of years a century ago to about seven years now.

The extra years lived on average by women has been attributed to basic differences between the X and Y chromosomes, but that seems unlikely, since it obviously does not account for the big increase for women compared to men in the last few generations.

It therefore seems more likely that this difference in like span is an abnormal effect of elevated shoe heels. After all, men and women are most typically affected in opposite ways, with their pelvises rotating in opposite directions backward or forward and their knees being bent in opposite directions, toward knock-kneed or bow-legged positions.

Therefore, preventing this difference by avoiding elevated shoe heels from earliest childhood and finding effective ways to compensate for it when it is already present, both actions taken together should result in roughly equivalent average like spans for men and women. And at a higher level for both, since abnormalities would be prevented or compensated for in both sexes.

36DOES UNNATURAL FUNCTION CAUSE CANCER?

The answer to this chapter title question would generally be yes, since for example a malfunctioning immune system is considered to be at least one cause of some types of cancer. But the question here is much more specific. Does the unnatural modern human function that follows from the unnatural form caused by shoe heels include an abnormal vulnerability to cancers of any type?

Cancer is a very complicated field of medicine, one in which I am certainly no expert. Nevertheless, I believe it is likely that the general state of abnormal system functioning in the human body caused by elevated shoe heels does logically because of its general malfunctioning include vulnerabilities to cancer that would not otherwise be present if such human body systems were in a natural form thereby enabled to function naturally.

Despite my belief, I feel certain there is no currently existing research that supports a direct linkage between elevated shoe heels and cancer. I doubt there has very been any research in that area, since it is unlikely that anyone has even conjectured a connection between the two things that seem so apparently unrelated.

My research in this area is at the very beginning, but an interesting angle has already presented itself. There was recently broadcast on television an excellent PBS series by Ken Burns on "**Cancer: The Emperor of All Maladies"**, which provides a three part in-depth history of attempts to treat the disease.

Near the beginning of the series, it covered a 1950's case study of identical twin boy toddlers, one of whom contracted leukemia and died. What caught my eye was a photograph of the two together that appeared to indicate that the body of the twin who died had apparent asymmetries and the other twin, who is still alive many decades later today, did not.

Since the twins were identical, they had no genetic differences, so there cannot have been a genetic cause to the cancer. The only difference between the twins apparent in the case study was the apparent physical asymmetry. That asymmetry probably went unnoticed at the time and what caused it is unknown. My guess is that was due to fetal development within the womb, but that's just an educated guess.

What seemed significant to me is that physical asymmetry was uniquely present with cancer. If elevated shoe heels cause physical asymmetry as I have shown, then it is logical to think that such abnormal form does lead rather inexorably to abnormal function, which certainly raises the strong possibility of abnormal vulnerability to cancer.

It therefore seems likely that a direct linkage between elevated shoe heels and cancer will be found, if we do but look carefully. If and when such a linkage is found, then the steps we will be taking to reduce human structural asymmetry anyway will also serve to reduce the vulnerability to cancer as well.

37EVOLUTION AND HIDDEN HUMAN PHYSICAL POTENTIAL

The misalignment of human joints and malformation of human bones, both caused by elevated shoe heels, severely reduces the strength of human muscles, particularly the major muscle groups. The specific weakening of the abdominals, gluteus maximus, and hamstrings were discussed earlier in Chapters 8-10.

Chimpanzees Are About 2.5 Times As Strong as Modern Men

The overall reduction in strength of the modern human body compared to our evolutionary forebears is quite significant. Our closest primate relatives, the chimpanzees (pan troglodytes), have been estimated to be roughly three to five times as strong as a modern man.

The well known primate researcher Jane Goodall has estimated that an adult male chimpanzee in the wild "would be at least six times stronger than a normal [human] male", based on her field observations.

Other tests with captive chimpanzees using a dynamometer came up with a figure slightly less than four times stronger than an average college student and about 2.5 times greater than an exceptional human subject (top 1 percent).

The most definitive study was a US Air Force study that tested a chimpanzee out-pulling a human weight-lifter by 2.5 times on a relative body weight basis. Besides much superior strength, the chimpanzees also demonstrated much superior muscle endurance[1].

Another more recent study compared bonobo apes (pan paniscus) to modern man in jumping tests with the bonobo performance roughly twice that of humans[1].

The current research consensus seems to be that ape muscle is intrinsically superior to human muscle (in Goodall's view and that of most other researchers). But of course the real answer is not that chimpanzees have "magic" muscles compared to us.

Rather it is that we as modern humans are unnaturally weak, due to the abnormal malformation of our bodies wrought by unnaturally elevated shoe heels.

38PREPARE TO BE SURPRISED

As I have said repeatedly in previous chapters, most of what we need to know about the anatomical and medical problems created by elevated shoe heels remains to be discovered. Existing research studies are very limited.

As a consequence, it is likely that we will repeatedly be surprised by what we find, particularly with regard to the surprising solutions that may be out there waiting to be discovered. Some preconceived notions are likely to fall by the wayside and some commonsense assumptions will likely be completely contradicted by what we find. That is the say scientific discovery often works.

We do know now from history that there have been some unusual individual cases in the past that we do not have sufficient knowledge now to explain. They may ultimately provide totally unexpected approaches to extraordinarily advantageous outcomes that are complete surprises, even the opposite of what is expected. I will recount a few historical cases that I know of as of now.

The Romantic Poet Lord Byron

One of England's greatest poets had from earliest childhood what was referred to as right clubfoot (although this exact diagnosis may well be incorrect). It caused a noticeable limp. Despite this significant handicap, he was a very powerful swimmer, an effective boxer, and a bisexual with a sufficiently extensive list of sexual conquests to be socially exiled from England.

The Great American Female Sprinter, Wilma Rudolph

The standout athlete of the 1960 Rome Olympics, the first to be televised, Wilma had polio at age four. She had to wear a brace on her left leg and foot (which was twisted) until age nine, and an orthopedic shoe for two more years.

Despite having to endure all this, Wilma in totally dominant fashion won gold medals in the 100 meter and 200 meter sprints, as well as the 4x100 meter relay.

Olympic Figure Skating Star Kristi Yamaguchi

Kristi was born with clubfeet and had plaster casts on her feet from the first couple of months until age one. Then she wore corrective shoes connected by a brace until age two. Despite this, she won gold medals at the 1992 Winter Olympics and World Championships.

Womens Soccer Superstar Mia Hamm

Mia was born with a clubfoot and wore corrective shoes as a young child. Despite this, she became arguably the greatest American female soccer star, leading the U.S. team to gold medals in both the 1996 and 2004 Olympics.

Hall of Fame NFL Quarterback Troy Aikman

Despite being born with a clubfoot, Troy led his Dallas team to three Super Bowl wins.

39WHAT SHOULD YOU DO NOW?

First of all and most importantly, do not panic! It would be a big mistake for you to try to make any sudden, major changes, either in the shoes you wear or other aspects of your current lifestyle. As I have mentioned previously, for example, suddenly transitioning to barefeet or very low heel shoes from much higher heeled shoes is very likely an injury mechanism in and of itself.

Just keep doing whatever you think is already working for you. Take it slow and easy for now.

I will make a few recommendations in this chapter for the first kind of new steps I think you should take. My emphasis and yours should be safety, first and foremost. Your personal creed should be the same as the physician's creed, “First Do No Harm”. Trust me, there are many, many ways you can make things worse for yourself. Please don't outsmart yourself.

I have to be very conservative right now about what I recommend to you. I want to be sure that I do not help you to harm yourself. There are no silver bullets to use here (vampires, if they existed, might be easier to deal with than shoe heels). I am acutely aware that most of the science that needs to be done to provide safe and reliable answers for all of us has not yet been done. That leads directly to my first recommendation for you.

(1) *Stay Connected to Be Updated With More Definite Recommendations for You, as Research Evolves in the Future*

One of my primary goals for the non-profit Anatomic Research Institute mentioned earlier is to communicate reliable information about the latest on the ongoing research on treatment and prevention to the public. In short, to provide trustworthy recommendations on a continuing basis to you.

So, at least for now, you can visit my website at **anatomicresearch.com** and sign up for email updates. All of this is very much a work in progress currently, but in the future I will likely be setting up social media and other fairly obvious lines of communication to make staying connected easier.

I will be posting video online demonstrating what I think are safe and effective stretches and exercises for you to counteract the adverse effects of that elevated shoe heels have probably had on you. That leads directly to my second recommendation for you.

(2) *Focus for Now on Weight Training Exercises and Stretches That Counteract the Adverse Effects of Shoe Heels*

It is going to take a while to sort footwear out relative to the elevated heel problem. You should not expect anything for a year or two, at best. At worst, it could be many years or never, at least in terms of new footwear designs that fix your problems, as versus simply not making them worse.

Weight training of even an informal type is important, since shoe heels have tended to weaken you and make you asymmetrical, particularly including your upper body. For cardiac heath, you need to have

balanced upper body strength. Building up your “core” strength is critical. Most important is to focus on your abdominals, glutes, and hamstrings.

Stretching, even simple stretches, are more important than you might think. I believe one of the most important is bending over carefully and touching your toes, or coming as close as your can without straining). That bending forward motion counteracts the backward rotation of the pelvis that elevated shoe heels cause, as previously discussed. See Gary Larson cartoon #2. Besides the lumbar spine, you need to stretch your thoracic and cervical spines carefully too.

I will posting a great deal more on the Web in the future with much more specific information on the best exercises and stretches and how to safely perform them, so again, stay in touch. I have some new stuff and some different ways of performing some older stuff, but I need more time to test with varied populations, including the elderly, who need the help the most but are much more frail than the general population thereby raising extra safety concerns.

I also will be posting information on how to better assess your personal asymmetry profile in order to tailor exercises and stretches specifically to counteract it adverse effects on your body.

(3) *Alternate Running and Other Aerobic Exercises*

I know it may be very difficult to do if you are an avid runner, but run less, to avoid becoming a former runner. Run only every other day, with weight training on the days between. When you run, alternate with periods of walking.

Also, do aerobic sports or exercises that involve lateral motion, like basketball or soccer or dancing, not just straight ahead repetitive motion. Racquet sports like tennis that typically involve swinging with one arm only, or golf with its twisting swing motion, probably increase whatever asymmetry problems you may have.

You can also try sports and exercises that don't involve natural human locomotion, like swimming and riding a bike. My personal experience is, however, that doing so will not counteract your asymmetries, just not make them worse.

Ironically, two exercises that I can think of may be helpful, rollerblading and cross-country skiing. They are unusual because they rely on an outward to the side, skating motion of your legs that is similar to the front end misalignment discussed in chapter 11, rather than straight ahead motion required by running and walking.

(4) Shoes and Barefeet

In the short term, I think the best you can do is try moderate the adverse effects of elevated shoe heels. To do that, you should avoid your highest heel shoes, both athletic and street shoes. You might even try moccasins or slippers with low heels instead of barefeet or flip-flops. The basic idea is to try to reduce the amount of change or transition between difference heel heights by converging toward the middle in terms of heel heights.

I think this approach is particularly important for women with special regard to high heels, especially spikes. I think you have to come down from these higher heels, especially if you are a serious athlete. I believe high heels are a really serious health problem. So many women have such a strong desire to wear them, apparently for sexual allure more than anything else, according to surveys. I can only say, as a guy, that I personally would vote instead for a more direct and healthy approach to increasing such allure, if one must, like clothing that is more shear and/or more revealing and/or as a last resort, more absent (meaning articles of underwear). Just a suggestion, medically speaking.

40ABSTRACT/CONCLUSION

However innocuous they may seem, the elevated shoe heels has seriously deformed the shape of the human body. Shoe heels are the direct cause for osteoarthritis, heart disease, stroke, low back and neck pain, scoliosis, and a surprisingly extensive host of other serious and widespread human diseases. The cause for those diseases have remained hidden for hundreds of years until now.

Without knowing the cause, effective treatment and prevention is difficult or impossible. This book describes the specific shoe heel interaction with critical anatomical structures that is the direct causative mechanism of the diseases.

The long hidden causative mechanism is this. The elevated shoe heel subtly shifts the lower ankle joint (subtalar ankle joint) to the outside, so that foot rolls sideways, tilting to the outside. That automatically causes the ankle joint and the lower leg to tilt out also.

The leg is thus forced into an abnormal, bow-legged position when flexed. The more it is flexed, the more it is tilted out. This turns out to be a big problem.

When running, the knee is substantially flexed at exactly the same time it is under a maximum load of 2-3 times body weight. And when running, the knee flexes again and again, substantially and under maximal normal load.

Unfortunately, humans run a very great deal during early childhood, just when the growing body is being formed. The unnatural bow-legged position gradually deforms the human body as it gets slowly baked into the skeletal structure. Most males are affected in a fundamental way that is different from the way most women are affected.

Every part of the human body ends up being adversely affected. This is because the effect of the perverse mechanism is greatest when the repetitive forces on the body are most powerful, which is during childhood running.

None of the supporting evidence for this discovery of a single underlying cause of many serious human diseases is new. The cause is firmly based on simply and logically connecting the dots between a few existing studies in anatomy and biomechanics. All of the studies upon which this discovery depend are well regarded settled science.,

Like the cause, the effects of elevated shoe heels on human anatomy are also firmly based in the same way on the best of settled science, including in addition from orthopedics, podiatrics, physical anthropology, and some other fields.

As difficult as it may seem to believe, the basic shape of your body has been permanently altered by elevated shoe heels. From your head to your toes, all of your body has been changed in fundamental ways from natural to abnormal.

ENDNOTES

Chapter 1. Introduction

1. Robbins & Hanna? (1988?)

2. Marti (1989)

3. Bramble and Lieberman (2004) While I find nothing to disagree with them relative to their discovery that humans evolves into a design optimized for endurance running, which made humans very successful predators. I think it is obvious and old news that man also evolved to run fast, so as to be successful as individual prey fleeing from a predator. In that context, I seem to recall an old joke about a conversation between two people being chased by a bear.

4. Richards (2009)

5. Born to Run The entire book is a fabulous read, but I recommend particularly Chapters 25 and 28, which provide much more detail on the research I cited by Robbins, Marti, and Bramble and Lieberman.

6. I am not counting Nike Free™ here because I think it is questionable to call them a barefoot-based sole design. They came out earlier, in 2004.

Chapter 2. ELEVATED SHOE HEEL CAUSES FOOT SUPINATION

1. Griffen (2010)

2. Kolker

3. Evans (adapted from Hicks)

Chapter 3. ELEVATED SHOE HEEL CAUSES KNEE TO TILT OUT

1. Rubin

2. Child activity levels

3. 70-90% knee load

4. knee arthritis

5. increasing heel height & load

6. Q Wood

7. Tate It is important to note here that the proceeding photographic samples in Figs. ? & ? were not cherry-picked from many other possible choices. They are simply the only ones I could find after an

extensive search of available studies ranging over the last century and a half. Hopefully this book will prompt field studies conducted at the various locations all over the world where that are many ancient bones potentially available for study by professional anatomists and physical anthropology.

6. du Toit

Chapter 4. THE VASTUS LATERALIS KNEE MUSCLE IS WEAKENED

1. Smillie (1980)
2. Smillie (1980)
3. Baroni (2013)

Chapter 5. THE ANKLE JOINT RESHAPED BY SHOE HEELS

1. *Wood 114*
2. *Wood 23*
3. *Napier*
4. *Woolf's Law (1892) The Law of Bone Remodeling (1986 Reprint)*
5. *Havelock Charles 6*
6. *Boulle(2001)*
7. *Colin et al (2014)*
8. *Cavanaugh (1987)*
9. *Nigg (1986)*
10. *Wells (1931) 225*

Chapter 6. THE FOOT RESHAPED BY ELEVATED SHOE HEELS

1. *James (1939)*
2. *D'Aout (2015)*
3. *Mays (2005)*
4. *Mafart (2007) See also Zipfel and Berger (2007)*
5. *Wells (1931) 259*

Chapter 8. SHOE HEELS TILT THE PELVIS BACKWARDS

1. *Bendix (1984)*

Chapter 12. UNNATURAL PELVIC SHAPE MAKES CHILDBIRTH VERY DIFFICULT

1. *Heyns ( ) and Derry (1924)*
2. *Trevathan (2010)*

Chapter 13. HIGH HEELS HAVE THE OPPOSITE EFFECT ON FEMALES

1. *Zifchock et al (2006)*

Chapter 14. Racial Differences

1. *Giladi (1985)*
2. *Cowan (1993)*

Chapter 15. SHOE HEELS MAKE RUNNING ASYMMETRICAL

1. *Sadeghi et al (1997 & 2000)*
2. *Stefanyshyn & Engsberg (1994)*

Chapter 17. SHOE HEELS MAKE RUNNING BAREFOOT POTENTIALLY DANGEROUS

1. *Hoerzer et al (2014) p.96, International Calgary Running Symposium*

Chapter 19. SHOE HEELS CAUSE LOW BACK PAIN

1. *Seay et al (2011)*
2. *Whitcome et al (2007)*

Chapter 21. THE MISALIGNED THORACIC SPINE AND THE HEART

1. Miles, M. (1944)

Chapter 26 THE RENAISSANCE AND REFORMATION

1. Semmelhack (2008)

Chapter 28. MEDICAL COSTS AND QUALITY OF LIFE

1. Marmot, Michael (2015) ***The Health Gap***

Chapter 35. EVOLUTION AND HUMAN PHYSICAL POTENTIAL

1. Sholz (2006)